THURSDAY, NOVEMBER 26, 1885

## *THE WHOLE DUTY OF A CHEMIST*

ON the 6th instant there was a meeting at the rooms of the Chemical Society in the afternoon, and a dinner in the evening, to celebrate the grant of a Royal Charter to an Institute of Chemistry.

The stated object of the Institute is to do for chemists what has been done for the members of different professions and trades by such bodies as the College of Physicians, the College of Surgeons, the old Guilds, and the modern Trades Unions.

This is possibly a very desirable thing to do, but to the student of pure science the creation of the new corporation possesses no other interest than that which results from the consideration of its prospective influence on the progress of science. Indeed the intention is so entirely commercial that we should not have referred to the new body at any length in these columns if the President, Prof. Odling, in an address delivered on the occasion, had not enunciated views which we believe all true men of science will read with pain, and against which we feel it our bounden duty to make a protest.

Before we proceed to deal with the address itself, it will be well to clear the ground by a few general considerations touching the applications of science to industry, and the manner in which, time out of mind, and we hope for all future time, scientific principles have been and will be brought down to be utilised in the ordinary affairs of life. First of all, it will be readily conceded that in the present state of civilisation there is scarcely any handicraft or manufacture or process in which some scientific fact or principle does not lie at the root of the matter. Our boots are the results of scientific applications, our clothes are the result of scientific applications, the materials depend upon science, the fit depends upon science. If one had to define offhand the difference between a profession and a trade requiring skill in making certain articles, one would say that the profession required more science than the trade, that is, there is not a difference of quality, but of quantity. The bootmaker that makes a boot, and the surgeon that cuts off a toe, both deal, if they do their work well, with the anatomy of the foot, but we expect the professional surgeon to know more about this anatomy than the shoemaker. Further, any science in the process of the amalgamation of its applications with other similar amalgamations at first begins by being in the hands of a few individuals, let us say of high training; it becomes generalised, and then finds itself in the hands of a greater number of individuals probably less highly trained, and so on, till each special application of science becomes the common property of the community.

*Au fond*, then, so far as science is concerned, we can recognise no distinction between a profession and a trade, or we may use the words an industry, if any one likes them better. These industries or professions once started are kept alive and fostered, and made more useful for mankind, by the perpetual introduction of new scientific facts and processes. This is as true for the improvement in leather and cloth manufactures, as it is in the curing of hydrophobia, which may some day come.

Chemical science, for example, is the very sap of the chemical industries, and there is the most intimate and the most direct connection between the researcher and the manufacturer. A Reichenbach discovers paraffin, and a Young straightway turns it into candles. Andrews demonstrates the true principles of the condensation of gases, and these principles are forthwith applied to the construction of a freezing-machine. The history of technology teems with instances of this kind. Indeed, some of the huge manufacturing concerns of the Continent are driven to anticipate the output of the purely scientific laboratories of the Universities and higher schools by employing investigators for themselves: the great colour-making manufactory at Ludwigshafen has two score of chemists at work on the industrial development of the chemistry of aromatic compounds. Now these investigators are in the first instance made by the Universities: they are the product of their great chemical schools—they are men who have caught something of the spirit of that noble army of teachers who have dedicated their lives to the advancement of natural knowledge for its own sake without thought of guineas or "leading professional position." The growth, then, of the chemical trades must depend ultimately on the help which chemists are able to give to the chemical traders. This help must consist either in new knowledge to be furnished directly by the chemist, or indirectly by the men whom he has so trained that they may know how to seek for it and to find it. Have we not here the true function and real duty of "those of us occupying the leading position in the profession" or "who have already attained the higher steps of the ladder of success," if such men are connected with an University?

The honour given to teachers from the beginning of time was accorded to them not merely for their learning but for the new knowledge they produced and taught. They were the guardians of the sacred fire; and the reverence with which they were regarded depended upon the constancy with which they fed the flame. The estimation in which men of science are held to-day, even if they are not teachers, is due to the national benefits which they confer by giving their lives to learning, teaching, and to writing books for others; and because such men are regarded as the highest benefactors of our race and the founders of our modern civilisation. The nation remembers them even if they often forget themselves.

Such men, however, do not exhaust the number of those who have studied science or who perform useful scientific functions. But the point is, however useful this other class of men may be—like the bootmaker and the tailor, who are eminently useful in their way—their knowledge is merely a stock-in-trade to which they look for their livelihood. We have nothing whatever to say against these men, but it is imperative that we should point out that if their object in life is merely to get money the public estimation of them cannot be expected to be the same as that accorded to those whose lives are devoted to the public good. Is it possible to tell one kind of man from the other?

This can be easily done. Let us assume that he is a professor of science at a well-known seat of learning. Are his lectures the best possible, or does he simply lose the time of his students for so many hours per term?

Is he the life of his laboratory, always there, always setting an example to his students of patient and continuous research? What is the number of researches produced per annum, and what is their value? Do his students revere him or think little of him? Do they give any indications of benefiting by his instruction? Has he founded a school? Has he impregnated his assistants with the love of new knowledge, and do they spend their time in getting it? Or, again, is he the friend of manufacturers, a *grata persona* to limited liability companies? Is he a noted expert in our courts of law? Is he never seen in his laboratory? Is the laboratory now silent, its appliances rotting from disuse, and its old reputation for research become merely the shadow of a shade?

It is really quite easy to find out whether this professor of science is doing his duty or neglecting it; whether the getting of knowledge or the getting of money is foremost in his thoughts.

The dignity of a professor in a seat of learning is closely associated with the dignity and the honour of the seat of learning itself. An University which appoints a man to a professorship places its honour in his keeping so far as his science is concerned. Now the members of an University, even though they may not be especially learned in any particular branch of knowledge, soon know, perhaps even by a kind of instinct, whether a professor is upholding the honour of the *alma mater*, in the welfare of which they are all interested; or whether by forsaking the fair fields of knowledge, and by thinking only of self and pelf, he is dragging her reputation through the mire. This feeling in an University affords another criterion which may be safely relied on if we wish to know whether or not a professor is doing his duty.

Take another case. Let it be that of one who is engaged in commercial matters—whether large or small is immaterial to our argument—into which scientific principles and ideas largely enter; or let us assume him to be engaged, on the strength of his scientific attainments, by a Government department or an industrial body which wishes to utilise his knowledge. Does he expand his routine work into an opportunity of enriching science? Does he make himself the recognised master of a large field of knowledge which he gives to the world? Do his labours confer honour on himself or on the body with which he is connected? Or, on the other hand, is his name never heard at a scientific society? does he merely, in short, content himself with the perfunctory performance of the work by which he makes his money?

We have referred to the dignity of a man of science; what does this mean? The view it expresses is simply the modern view representing that feeling of olden time which made teaching so honourable while trade was despised. Then, as now, the man was often poor, but he spent his life in doing a common good, while the trader was often rich, and dispensed his wares for his own advantage. Nowadays the dignity of a leading man of science is somewhat difficult to define exactly, but the same idea lies at the bottom of it. It is known that he cares more for science than for money. It is known that his whole heart is in his researches; even when they happen to be profitable to himself or to others, he is still not a money-grubber. This dignity is not confined to professors, but a man to possess it must be something more than commercial or professional. We cannot imagine a bootmaker or a tailor on the council of the Royal Society, but yet he employs scientific processes to get his money as much as a chemist does who spends his time in commercial analyses or in courts of law. To come back to our criterion, we think we have indicated that there are various ways in which men of science can be allocated in the two classes to which we have referred.

We now proceed to refer specially, and as briefly as we can, to Prof. Odling's address. It begins with a history of the movement, and then goes on to show the ever-increasing need there is of "professional services" which are rendered by men of various grades, "from those of us occupying the leading positions in the profession, to the most humble individual practising in our ranks." We are dealing, then, with the chemists employed by Government and large corporations, as well as "experts" and analysts; and among these latter not only with the man of "leading position" who charges ten guineas for analysing a sample of water, but with the assistant who actually does the work for the not excessive sum of half-a-crown.

We next read as follows:—

"It would seem, however, from observations not unfrequently hazarded by some very superior persons, whose happy mission it is to put the rest of the world to rights, that there is something derogatory to the man of science in making his science subservient in any way to the requirements of his fellows, and thereby contributory to his own means for the support of himself and of those depending upon him. Now, on this not uncommon cant of the day a little plain speaking would seem to be very much wanted. While the investigation of nature and the interpretation of natural law are admittedly among the highest, as they are among the most delightful, of human occupations, the right application of natural law to effect desirable objects is in itself a scarcely less worthy occupation; many of these objects being of paramount importance, and attainable only by the exercise of high scientific sagacity and skill, aided by a fertility of resource and a persistent elasticity of spirit, ready ever to cope with the successive novel difficulties found to be continually opposing themselves."

On this we have to say—and we shall return to the point further on—that we know of no one who has made the abstract proposition which Prof. Odling condemns. We are prepared to say, however, that in the opinion of many who are not men of science, the appearance of a man of science, occupying a "leading position" as an expert in a court of law, whose "devotion" to his employer causes him to apparently contradict the statements of another man of science on the other side, doubtless equally "devoted," does not add to his dignity. A well-known lawyer, now a judge, once grouped witnesses into three classes: simple liars, damned liars, and experts. He did not mean that the expert uttered things which he knew to be untrue, but that by the emphasis which he laid on certain statements, and by what has been defined as a highly cultivated faculty of evasion, the effect was actually worse than if he had.

It is consoling to think that the qualities most valuable in an expert, since experts there must be, are not those for which men of science are best known. Coolness under cross-examination, verbal dexterity, a ready wit, not too much knowledge or conscience, the fidelity of a partisan, or rather "*professional devotion*," and a dash of impudence, are quite as frequently the passport to the "professional eminence" of an expert as scientific ability.

Surely it is not necessary for us to point out the sophistry and fallacy of the argument that "the right application of natural law to effect desirable objects is in itself a scarcely less worthy occupation" than "the investigation of Nature and the interpretation of natural law," when such applications are made at the instigation of an individual—a client—who pays for such application of natural law at the rate of so many guineas a folio; and who, if it suits him, may then proceed incontinently to suppress "the right application of natural law." Are we to elevate such service as this to a high moral platform, and claim for it the same homage or appreciation which is accorded by the outside world to work done unselfishly and for the benefit of the whole community?

Prof. Odling strengthens his view that we should by the following considerations:—

"In this matter, as in so many others, the sense of proportion is but too often lost sight of. Because the investigations of a Newton, a Darwin, a Dalton, a Joule, and a Faraday have an importance of which few among us can adequately conceive even the measurement; because among the scientific men now or but lately living in our midst are to be found those whose investigations in pure science have not only won for them a high renown, but have earned for them the gratitude, and should have obtained for them the substantial acknowledgments, of their country and the world; and because even the minor investigations and discoveries, placed before the world for the world's use, and not merely to enrich a firm, that are ever being made in pure science have all of them their merit and their value, it does not follow that the mere accomplishment, it may be in an abundant leisure, of two or three minor investigations, however creditably conducted, are to lift their authors into a scientific position altogether above that of men whose laborious lives have been spent in rendering their great scientific attainments directly serviceable to the needs of the State and of the community. The accomplishment of such-like investigations does not entitle their authors to claim exemption from the duty of earning their own livelihoods or give them a claim to be endowed by the contributions of others with the means to jog leisurely along, without responsibilities and without anxieties, the far from thorny paths of their own favourite predilection. However heterodox it may be thought by some, the best of all endowments for research is unquestionably that with which the searcher, relying on his own energies, succeeds in endowing himself. The work to which our natures are repugnant, not less than the work which entrances us and hardly makes itself felt as work at all, has to be done. In some degree or other, we have most of us to obtain our own livelihood; and harsh as may seem the requirement, it will, I suppose, be conceded that the necessity put upon the mass of mankind of having to earn their daily bread is an arrangement of Providence which has on the whole worked fairly well; and, further, that the various arrangements hitherto tried for exempting certain classes of men from the necessity of having to earn their daily bread, in order that they might give themselves up to the higher spiritual or intellectual life, have scarcely, to say the least of them, worked quite so satisfactorily as they were intended to. All of us are, without doubt, qualified for higher things than the mere earning of our daily bread; but the discipline of having to earn our daily bread is, in more ways than one, a very wholesome discipline for the mass of us, and even for the best of us. It may here and there press hardly on particular natures, but it is rarely an impediment to the achievement of the highest things by those having the moral qualities, the judgment, the determination, and the self-denial necessary above everything else for their achievement. Not a few of us may consider ourselves fitted for higher work than the gods provide for us, and fondly imagine what great things we should effect if we could only have our daily bread supplied to us by the exertions and endowments of other less gifted mortals. But experience is not on the whole favourable to the view that, the conditions being provided, the expectation would be realised. Experience, indeed, rather favours the notion that it is primarily the necessity for work, and association with those under a necessity to work,—those in whom a professional spirit has been aroused, and by whom work is held in honour,—that creates and keeps up the taste and the habit of work, whereby the vague ambition to achieve is turned to some productive account. Take, say, a thousand of the most eminent men the world has produced, and making no allowance for the large influence of descent or training, or of association with those to whom work is a necessity, or having been a necessity has become a habit, consider what proportion of these men have, by their means and position in early life, been free from any stimulus or obligation to exert and cultivate their powers: and consider, on the other hand, what proportion of them have been stimulated to exertion and success by the stern necessity of having either to achieve their own careers, or to drop into insignificance, if not indeed into actual or comparative degradation and poverty. We ought, indeed, all of us to be students, and to be above all things students; but the most of us cannot be, nor is it desirable, save in the case of a special few, that we should be only students. We have all our duties to fulfil in this world, and it is not the least of these duties to render ourselves independent of support from others, and able ourselves to afford support to those depending upon us. Fortunate are we in being able to find our means of support in the demand that exists for the applications of a science which has for its cultivators so great a charm. To judge, however, not indeed by their coyness when exposed to the occasional temptation of professional work, but rather by their observations on the career of others, the most sought after and highest in professional repute, the pursuit of professional chemistry is, in the opinion of some among us, a vocation open to the gravest of censure. It is praiseworthy, indeed, for the man of science to contribute to his means of livelihood by the dreary work of conducting examinations in elementary science for all sorts of examining boards, and by teaching elementary science at schools and colleges, and by giving popular expositions of science at public institutions, and by exchanging a minor professorial appointment, affording abundant opportunities for original work, in favour of a more lucrative and exacting appointment involving duties which, if rightly fulfilled, must seriously curtail these same opportunities. It is praiseworthy of him to add to his means by compiling manuals of elementary science, and by writing attractive works on science for the delectation of general readers; but it is, forsooth, derogatory to him, if not indeed a downright prostitution of his science, that he should contribute to his means of livelihood by making his knowledge subservient to the wants of departments, corporations, and individuals, alike of great and small distinction, standing seriously in need of the special scientific services that he is able to render them.

"A glance back suffices to show how foreign to the ideas of the great men who preceded us is this modern notion of any reprehensibility attaching to applied or professional science. In his earlier days, Prof. Faraday was largely employed in connection with all sorts of practical questions, and until almost the close of his life, continued to act as scientific adviser to the Trinity House. No man was more constantly occupied in advising with regard to manufacturing and metallurgic and fiscal questions than Prof. Graham, who ended his days holding the

official position of Master of the Mint; a position in which he succeeded another eminent man of science, less known, however, as a chemist than as an astronomer, Sir John Herschel. . . .

"So far, moreover, from his professional eminence and usefulness being made a matter of reproach to the scientific man, it should constitute rightly a claim to his higher consideration; and far from being accounted a disparagement, should be held as an addition to his scientific standing. In the professions most allied to our own on the one side and on the other this is well recognised. The physician and the engineer are not merely students of pathology and of mechanics, however important may have been their contributions to pathology and mechanics respectively, but they are the distinguished craftsmen in their respective arts. And whether or not they may have made important contributions to pure science, their rank as eminent scientific men is everywhere and rightly conceded to them. A lucky chance happening to any professional man may indeed bring him to the front, but no succession of lucky chances can ever happen that will of themselves prove adequate to keeping him there. Great qualities are ever necessary to sustain great professional positions; and to be for years one of the foremost in a scientific profession is of itself at least as substantial an evidence of scientific attainment as is the publication of a memoir on some minute point, say of anatomy, or chemistry, or hydrodynamics, for example. And it is so recognised, and very properly recognised, even in quarters where pure science admittedly reigns supreme. Leading engineers and leading physicians and surgeons are every year admitted into the Royal Society, not on account of the importance attaching to any special contributions they may have made to mechanical or pathological science, but mainly because of their eminence in their several professions, in which to be eminent is of itself an evidence of scientific character and of extensive scientific knowledge. It may indeed be taken as beyond question that to obtain and retain a leading position in a scientific profession, needs among other things the possession of high scientific attainments. I say among other things, for without moral qualities in a notable degree, sympathy, endurance, courage, judgment, and good faith, no such professional success is conceivable. Professional eminence is the expression necessarily of scientific ability, but not of scientific ability alone. The self-engrossing science of the student has to be humanised by its association with the cares and wants, and the disappointments and successes of an outside world."

Having given this long extract from the address, we now proceed to remark on certain parts of it.

In the whole of Prof. Odling's references to the endowment of research, which was so warmly advocated by his predecessor at Oxford, Sir Benjamin Brodie, there is much evidence that he has not even begun to understand the question. No one has ever proposed to endow research for the benefit of the researcher, or to endow researches which are immediately remunerative. The highest needs of the nation and of learning have been alone considered. The idea of endowment was only suggested for the encouragement of such researches as promised no immediate return in the shape of utility, except as pure knowledge. Prof. Odling seems to imagine that if the Fellowships of an University were awarded to men of eminence in science or who had given proof of skill in research, the Fellows would be but charity-boys of larger growth. When Prof. Huxley told the Americans that any country would find it greatly to its profit to spend 100,000 dollars in first finding a Faraday, and then putting him in a position in which he could do the greatest possible amount of work, he was not thinking that Faraday would thus be enabled to give nice dinners, but of the results of that greatest possible amount of work—the new knowledge that would be certain to be garnered and utilised some day for the nation's good. The endowment of research, or aid to research in any form, seems to be so objectionable to the President of the Institute, that the winding up of the Research Fund of the Chemical Society would seem to be one of the most desirable things of the present time, if his opinion is to prevail.

Prof. Odling employs in his argument a well-known method of procedure often used to throw dust in the eyes of a jury. He has put up a bogus case in order to demolish it very much to his own satisfaction. We fear that in this process he has been guilty of much, doubtless unconscious, misrepresentation of many revered names in science. This dummy is the assumed opinion of men of science that a man of science should do nothing to help industry directly. This opinion, as we have before stated, nowhere exists. The opinion does exist, as we have already implied, that such assistance must not interfere with higher work if higher work has been undertaken; and the general consideration of the man of science has risen enormously when it has been known that such aid, when given, has been given openly to all-comers, and not in secret to him who could pay the highest fee. Prof. Odling, in apparent justification of his case, quotes, amongst others, the names of Faraday and Graham, and states roundly that they have done the thing to which the superior persons to whom he refers object. This is untrue; no men were more faithful to their trust than Faraday and Graham, and the proof of our contention lies in the fact that their names are honoured among us while others, their contemporaries, the Ures and Lardners of that day, although men of tremendous "professional eminence," are already forgotten, or live only in the pages of a Thackeray. It has been stated over and over again that such was the fidelity of Faraday to his trust that he refused sums which would have amounted in the aggregate to a large fortune which were offered to him by manufacturers and others to tempt him to neglect his public work for their private advantage. It was a subject of pride to him that he had refused pay for all work he had done for the Government except on one occasion when he accepted it for the sake of a coadjutor. The volumes of Faraday's and of Graham's researches, not to mention those of other honoured names, representing their fidelity to pure investigation during the whole of their working lives, are, after all, the best answers to Prof. Odling, and when we contrast their faithful and long-continued activity in this direction with that of others which began with almost as fair a promise, and then suddenly, before the men were in their prime, was seized by a paralysis or else diverted into other channels, we have an indication, by no means to be despised, of the possible result of merely commercial work.

We believe that some chemists, although they hold the views which we express in this article, have allowed their names to be connected with the new institution, because they think that it may eventually, somehow or other, aid chemical education in this country. We think that this is an error. The College of Physicians has been pointed out as a precedent for the Chemical Institute. Now what

has the College of Physicians done for medicine and for medical education? Although it was one of the first founded of the Professional Guilds, we have had repeated occasion to point out in these columns that in the opinion of the most competent authorities, medical education even to-day is the worst organised and least effective.

The latter part of the extract gives Prof. Odling's view as to the easy admission afforded by professional eminence into the Royal Society. As regards engineers, we have never heard of any one being elected into the Royal Society except on the ground of his contributions to science. Commercial or professional eminence has, so far as we know, not been considered. As regards doctors, owing to the ancient ties of the Royal Society with medicine, we believe that it has been the custom to consider, in judging their claims, that marked eminence in their profession should be taken into account; but professional eminence *alone* does not decide the choice. In saying this we do not express our own opinion merely; and we must add that there is no written law in the matter, the decisions each year resting with the Council of that year, and the Council, as is known, is an ever-changing body.

The latter part of Prof. Odling's address, which we have not space to give at length, deals with the advantages which in his opinion are likely to result from the new organisation. He also gives some paragraphs from the preamble of the charter under which the Institute has now been incorporated. One of these paragraphs runs as follows:—"That the said Institute was not established for the purposes of gain, nor do the members thereof derive or seek any pecuniary profits from their membership." We confess we find it difficult to harmonise this extract from the charter with the general drift of the part of the address now under consideration; for although Prof. Odling frankly acknowledges, to quote his words, "to those of us who have already attained the higher steps on the ladder of success it can scarcely afford any personal advantages whatever," it is clear that this is not to obtain universally. Among the "advantages" we find not only "gain to the public" but "gain to ourselves"; we read of "noteworthy advantages, social and material, to the persons" who form the Institute. We also read: "Among its other objects, the Institute of Chemistry exists undoubtedly for the purpose of improving the position and prospects of professional chemists"; we further find that the Institute "will add alike to the social and substantial attractiveness of the chemical profession."

We do not find too many references to researches not of a directly remunerative kind, but Prof. Odling makes one concession: he thinks that among the members of the Institute "some proportion, at any rate, will find the pursuit of research the vocation for which they are especially qualified, and for which they will, IN THE SEED-SOWING TIME OF THEIR LIFE, be willing to make, as others have made before them, even considerable professional sacrifices."

*Ilias in nuce.* In the phrase we have put into capitals we have the real key to the address. It would appear that the life of a chemist should be divided into two periods—Seed-time and Harvest. Research may be the seed, the harvest must be gold. The continued pursuit of truth, the continued love of science for its own sake, may be left to the unwise. The ideal chemist is one who uses research only as an investment. He carefully limits it to his earliest years. By it he is to gain a reputation as a man of science. His reputation thus gained procures for him a post of high scientific honour and position. The "seed-sowing time" is now over. The golden harvest is ripe. It has to be reaped and garnered. The duties of the position of honour obtained by the original investment are therefore to be thrown to the winds in order that this may be done. He is now a man of "professional eminence": he is now on "the higher steps of the ladder of success."

Does any one think that his electors have a right to protest or his friends to lament? Certainly not; they have no such right. Their feelings have simply arisen from their ignorance of the Whole Duty of a chemical Man.

In these days of rapid intercommunication among nations we know that Prof. Odling's address will be carried to our brethren beyond the seas and to many centres of scientific activity in other lands. We wish it to be known, therefore, that the spirit it breathes is an alien spirit, repugnant to students of pure science in this country.

## *CENTRAL AMERICAN COLEOPTERA*

*Biologia Centrali-Americana. Insecta: Coleoptera.* Vol. I. Part I. By H. W. Bates. (London: R. H. Porter, 1881-84.)

THIS part of Godman and Salvin's great work is now complete, and though called a part is practically a volume, with introduction, indices, and completed pagination; its publication has extended over four years. It deals with the two great families of carnivorous beetles—the Cicindelidæ and Carabidæ—and consists of 316 pages of letterpress and thirteen plates of coloured figures. The number of species of the two families recorded from the region is 1086, belonging to 154 genera. Nine new genera and about 450 new species are described, this latter figure including, however, a certain number of species characterised for the purposes of this work in the *Proceedings* of the Zoological Society for 1878 and a few others similarly dealt with in the *Annals and Magazine of Natural History*. In his introduction the author touches on some points of geographical distribution, and states that the inclusion of the central highlands of Mexico and Guatemala in the Nearctic province by Wallace is not supported by these insects, but that on the contrary they markedly confirm the essentially Neotropical character of the Central American fauna. He also is inclined to adopt the opinion that the Central American region comprises two distinct sub-provinces, as proposed by Salvin from his study of the birds, the line of division passing probably across Nicaragua; and considers that even the more northern of these sub-provinces is not a southern extension of the Nearctic province, but rather a remarkably distinct sub-province of the Neotropical fauna.

In the body of the work the distribution and extent of each genus is briefly stated, and, so far as known, every

locality within the region for each species is recorded; thus, as so large a number of new species are described, it is evident that the volume will be an indispensable necessity to every future student of the Neotropical Adephaga. It contains moreover what is practically a new classification of the family Carabidæ. Its author has long been known and respected as an entomological systematist, for it is now nearly twenty-five years since he inaugurated a rational classification of the Rhopalocera or butterflies. He has been recognised since the death of Baron Chaudoir as the one entomologist possessing an extensive yet intimate knowledge of the Carabidæ of the whole world. But Chaudoir, though he published a crowd of valuable memoirs on the family, died without leaving behind him any general work on its classification. It is therefore a matter for congratulation that the author of this beautiful volume has presented us with a systematic arrangement as complete as the faunistic nature of the work permitted; it is one that requires, indeed, comparatively little supplement from the faunæ of other countries to render it quite complete. Assisted by the labours of Latreille, Dejean, Lacordaire, Schiödte, Leconte, and Chaudoir, and availing himself largely of the valuable work recently published by Horn, he has been able to form of the numerous sub-families, which are the equivalents of Horn's tribes, aggregates of greater importance, which he terms subdivisions. The family Carabidæ is of such enormous extent—12,000 species being known, with a vast number of others to come—that the necessity of some series of intelligible aggregates subordinate to the division, but superior to the tribe or sub-family, is undeniable, and Mr. Bates' attempt to furnish such a series is therefore of great value, even though his subdivisions are at present capable of only loose and partly traditional definition. The division II, of Carabidæ comprises eight of these subdivisions based chiefly on the form and sexual clothing of the male tarsi and on the form of the apices of the elytra. It is evident that the classification of such an enormous complex as the Carabidæ will require for its perfection the combined efforts of many naturalists, and if Mr. Bates's subdivisions are sufficiently natural they will be gradually evoluted and perfected by others, and we may therefore indicate that the first of them, viz. the Diversimani or Pedunculati seems scarcely tenable. The variability of structure of an organ amounts only to a negative, not a positive statement, and is therefore useless for practical purposes; and if we add to this, that other characters now considered in the Carabidæ to be of much importance, such as the number of glabrous joints at the base of the antennæ, are also subject to much variation in the aggregate, it is evident that a change in its composition is inevitable. We would also venture to call in question the propriety of treating the Pseudomorphinæ as merely a sub-family of Truncatipennes. Horn accords them the much higher rank equivalent to the "division" of Bates, and as they are to a considerable extent synthetic between the universally recognised two great divisions of Carabidæ, it is probable that this will, from a systematic point of view, prove nearly correct. Bates, however, only expresses himself with considerable hesitation on this point, and as the group is chiefly Australian, it will devolve on some student of the Australian fauna to work out this question of primary importance to the classification of the Adephaga.

The thirteen plates with which the volume is adorned supply coloured figures of no less than 325 species representing upwards of 100 genera. The figures are lithographs coloured by hand, and though they are, we believe, about the best that can be obtained in this country at present, they are certainly not equal to some of the refined lithographic figures of insects that have in recent years been produced in Austria; they are, however, so good as to enable the species to be recognised from them with certainty, and will therefore be a very welcome boon to entomologists.

Messrs. Godman and Salvin, the editors of the work, are to be congratulated on this satisfactory completion of the first part of the Coleoptera. No faunistic work that has hitherto been published gives anything near to so complete an idea of the vast wealth of tropical nature in insects, it being usual for only a few of the more conspicuous forms of this class to be described or illustrated; and if the Insecta can be completed in a manner at all corresponding to this first instalment, we shall have a work quite without rival in its way, and that will be pointed out as an illustration of what can be accomplished in our country and generation by the liberality and energy of private individuals. The assistance rendered to science by the publication of this volume has been supplemented by the presentation to the nation of the magnificent collection of Geodephaga accumulated by Mr. Godman for the purposes of the work; it consists of 986 species, and nearly 8000 specimens, something like 400 of the species being represented by the typical examples, and is now in the British Museum of Natural History at South Kensington.

D. S.

## OUR BOOK SHELF

*Outlines of Natural Philosophy.* By J. D. Everett. (London: Blackie and Sons, 1885.)

"THIS book is intended to supply the widely-felt want of a work at once easy enough for a class reading-book and precise enough for a text-book." "The woodcuts with which the work is profusely illustrated are not thrown in for mere ornament, but have been carefully *designed* and selected for the elucidation of the text, and are fully explained." Had it not been for the single word which we have put in italics in the second of these extracts from the Preface, we should have at once concluded, from its general tenor, that this work was written to explain a long series of plates (most of them unmistakably French) which have already done duty in various elementary books. We were reminded of Warrington's exhortation, when he brought the proof-plate to Pendennis:—"Now, boy, here's a chance for you. Turn me off a copy of verses to this."

These plates form a wonderful collection. Some are really excellent; not only from the scientific, but even from the artistic, point of view. In others, notably Figs. 88, 93, 94, 101, 102, 130, 160, the artistic predominates over the scientific to such an extent as to render them positively misleading to the beginner. Thus in Fig. 88 the shadow of a sphere, cast by a luminous point on a plane, is drawn in such a manner as to outrage all the Laws of Projective Geometry; and the pleasing sketch Fig. 93 can only be explained (if at all) by a most peculiar state of the air over the still water. Thus, the eaves of a house are depicted as seen by reflection at a portion of the water-surface, from which (as the drawing

shows) they are absolutely concealed by a hedge, while the image of the sloping roof above appears exactly as the roof itself does to the distant spectator who is nearly at the same level! Such at least must be the case, unless we make the audacious supposition that the more distant parts of this picture represent a flat surface, the drop-scene of a theatre!! Let the reader try to put his hand and its images in the aspects shown in Fig. 94; or let him try, as in Fig. 101, to see by *all but direct* reflection in a concave mirror an object situated far beyond its rim! On the other hand there are some wierd or Rhadamanthine scenes (as Figs. 134, 135, 138); and a couple at least (Figs. 99, 139) quite Lavaterian in their graphic realisation of human imbecility.

With such a frame-work or skeleton what could be expected of the book? Certainly not much; and it is so far to the credit of Prof. Everett that he has realised a fair amount of that little. But to what class of readers this book can possibly be of use, is one of those unfathomable questions which only a Mental Philosopher dares to attack. There is not, so far as we have seen, any *reasoning* in the book. Statements merely, and illustrated by pictures! To each paragraph, when the imprint of its figure-nucleus or *cliché* has been exhibited, we might append a slight but important variation of the usual mathematical formula:—

QUOD ERAT MONSTRANDUM!

*The Moon, Considered as a Planet, a World, and a Satellite.* By James Nasmyth, C.E., and James Carpenter, F.R.A.S., late of the Royal Observatory, Greenwich. With 26 Plates and numerous Woodcuts. (London: Murray, 1885.)

THIS is a third edition of a book which we have already reviewed in our columns. The two previous editions were issued in the quarto form, the present one is in the octavo. It is well known that this work contains the most exquisite illustrations of lunar phenomena extant. They chiefly consist of photographs of models which, when placed in the sun-light, faithfully reproduce the lunar effects of light and shadow. Lovers of astronomy are much indebted to Mr. Nasmyth for his brilliant idea, and it is to be hoped that this re-issue in a cheaper form will bring this admirable volume within the reach of many who have previously been debarred from perusing it.

## LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

### Weather Forecasts

IN your number for November 2, 1882, you were kind enough to insert a letter from me on the subject of "Weather Forecasts." The letter was occasioned by what appeared to me a conspicuous failure in the forecast which was published in the newspapers for October 24. In consequence of communications which followed the publication of my letter and my own consideration of the subject, I was led to move in the House o Lords for a Return of the "Storms which have visited the British Islands between January 1, 1874, and December 31, 1883, and of which no warning has been issued from the Meteorological Office; with a Notice of the Quarter from which each Unwarned Storm has reached the Coast." This Return, which was ordered to be printed August 7, 1884, is in some respects a remarkable document. It contains a record of nearly 120 unwarned storms, or an average of nearly 12 in each year. Large as this number appears to be, I was not encouraged by the correspondence which I had with several experts to hope that much could be done to improve the system of forecasting, and I have taken no further action.

One point, however, connected with the Return appears to me to deserve notice.

On examining it I found to my surprise that the storm of October 24 was omitted altogether. This seemed to me to be strange; but my friend, the Rev. F. Redford, a well-known local meteorologist (since deceased), gave me some technical explanation of the omission with which I was compelled to rest content. In the interesting Blue-Book, however, entitled "Principles of Forecasting by means of Weather Charts, by the Hon. Ralph Abercromby," issued by the authority of the Meteorological Council, I find the failure connected with the great storm of October 24, 1882, duly chronicled and recognised. These are Mr. Abercromby's words (p. 91):—

"Our last illustration will be that of a kind which fortunately rarely occurs, viz. the sudden formation of a cyclone in an unexpected position, which entirely upsets all forecasting. In Fig. 62 [the figure is of course here omitted] we give a chart for 6 p.m., October 23, 1882. In it we see the most familar features of the westerly type of weather, and though the barometer was falling over the Bay of Biscay and rising over Scotland, there was no reason to expect that the ordinary sequence of that kind of weather would be disturbed, that is to say, that west and south-west winds, with rather showery weather, would prevail. Accordingly the following forecasts were issued."

Then follows the table of forecasts as given in my letter before referred to, and ending with "Warnings, none issued."

"When we come to look, however, at Fig. 63 [this figure here omitted], the chart for 8 a.m. the following morning, we find that a small well-defined cyclone had formed during the night over the English Channel, which moved during the day towards north-north-east, and thereby produced continuous rain with complete shifts of the wind through 180° in many parts of the country, *so that the forecasts issued were a complete failure.*"

Now, observe Mr. Abercromby's practical conclusion:—

"It may be well to consider how failures of this sort may be guarded against. The answer undoubtedly is, by taking observations at shorter intervals than fourteen hours, as on this occasion. On this particular night a halo—a sure sign that the cyclone had begun to form—was seen near London at 10 p.m., and it is therefore certain that if the observations could have been taken at 11 p.m., or midnight, *such a complete failure might have been avoided.*"

These words seem to imply that something more might be done to give warning of storms. If we undertake to give these warnings, we ought not to let any question of expense stand in the way of making the warnings as complete and as correct as possible. An unwarned storm occurring on an average once a month is a serious consideration. It is not worthy of the greatest maritime nation in the world to be neglectful or niggardly in this matter.

H. CARLISLE

Rose Castle, Carlisle, November 20

P.S.—I forward herewith a copy of the Return of "Unwarned Storms."

### Scandinavian Ice-Flows,

REFERRING to the map in Croll's "Climate and Time," which is reproduced in his "Climate and Cosmology" (p. 133), and which traces the ice-flows of the Glacial period from the two sides of the Scandinavian peninsula, it will be seen that the said flow bifurcates in the North Sea, and that the bifurcation is at the position of the Dogger bank. I should be glad to be informed whether this fact has been observed or commented upon in any geological work.

J. D. HOOKER

Kew, November 23

## Can an Animal Count?

SIR JOHN LUBBOCK, in his interesting paper on animal intelligence (NATURE, vol. xxxiii. pp. 46-7), virtually puts this question with reference to the dog. But the question whether a dog, or any other animal, can count will depend upon what we mean by counting. In the ordinary and correct signification of the term, counting consists in applying conventional signs to objects, events, &c., as when we say "one," "two," "three," to the striking of a clock. Clearly in this sense there is no reason to suppose that any animal can count. But there is another sense in which the term "counting" may be used—*i.e.* as designating the process of distinguishing, with respect to number, between the relative contents of two or more perceptions. While addressing an audience of 100 individuals a lecturer can immediately perceive that it does not contain 1000; and even without, in the true sense, counting them may make a tolerably close guess at their number. The accuracy of such a guess will depend upon two conditions. The first of these is the number of units to be computed, and the second is the previous practice he may have had in that kind of computation. Thus, every man is able to tell the difference between one and two, two and three, &c., up to perhaps seven and eight objects or events, without resorting to the expedient of marking off each with a separate sign. But somewhere about this point most persons require to adopt a system of numerical notation, if they desire to be accurate; and probably no one, without either special practice or some such system, could be perfectly sure whether he held eleven or twelve shillings in his hand, or whether a clock had just struck eleven or twelve. Indeed, it is just because of the rapidly-increasing difficulty of thus computing diminishing differences of ratio by immediate perception, that primitive man first lays the foundations of arithmetic by marking off the objects or events upon his fingers and toes. As already indicated, however, special practice makes a great difference in the accuracy with which such instantaneous computation can be made. Several years ago Prof. Preyer, of Jena, tried some experiments upon this subject, and found, if I remember correctly, that after a course of special training one might acquire the power of instantaneously distinguishing between twenty and twenty-one dots promiscuously scattered over a piece of paper.

Now, it is clearly only in this way that animals can be supposed to count at all; and, therefore, the only question is as to how far they are able to take immediate cognisance of the precise numerical content of a perception—or, in the case of a series of events, how far they are able to take similar cognisance of their past perceptions. But, as Sir John Lubbock observes, there is no record of any experiments having been made in this direction. Houzeau (tom. ii. p. 207) says that the mules used in the tramways at New Orleans are able to count five; for they have to make five journeys from one end of the tramway to the other before they are released, and they make four of these journeys without showing that they expect to be released, but bray at the end of the fifth. If this is really a case of "counting," in the incorrect sense of the term (and not due to observing some signs of their approaching release), it is probably due to their perception of a known amount of fatigue, a known duration of time, or some other such measure.

Several years ago my sister tried to teach an intelligent terrier to fetch a stated number of similar little woollen balls placed in a box at a distance from herself—the number stated, or ordered, being purposely varied from one to six. But although she is good at teaching animals, and here went to work judiciously in ways which I need not wait to describe, the result, as in the case given by Sir John Lubbock, was a total failure.

My object in making these remarks is to point out that in experiments of this kind the game seems scarcely worth the candle. Even if it were proved that a dog could "count" up to any particular number, all that we should have proved would be that the dog is able to distinguish between the degrees of two or more perceptions of a given kind; we could not thus prove any abstract conception of number on the part of the animal, such as is implied on the part of the "Damara floundering hopelessly in a calculation." Howsoever hopeless such floundering may be if the man is really *calculating*—*i.e.* employing some system of numerical signs—his operations are being conducted on a totally different psychological level from those of the bitch who, in surveying her litter of puppies, perceives that there is not so great a mass of them as she remembers to have perceived before. Psychologically considered, the artifice of numerical notation is as far above any such faculty of simple perception, as the artifice of alphabetical writing is above that of simple association. I cannot doubt that a moment's thought would have shown Sir John Lubbock how needless was his precaution—while establishing certain associations of ideas in a dog's mind between written words on a card and the things signified—of spelling the words phonetically, "so as not to trouble him by our intricate spelling."

It is a most interesting fact that a dog's attention can be so far fixed upon written signs that a special association of ideas admits of being established between them and the things signified; but the psychological distance between establishing such a special association and spelling a word is so enormous as not to admit of computation. And similarly, even if my sister had succeeded in teaching her terrier to fetch a stated number of balls at word of command, no one could have supposed that she had thus taught the animal to count, in the sense of employing any system of numerical notation: she would only have proved the degree in which this animal was able to perceive, *without counting*, the different appearances presented by this, that, or the other volume of balls in a box.

GEORGE J. ROMANES

## Lodge's "Mechanics"

PERMIT me to thank Prof. Tait for his kind and amusing criticism of my little book. I am struck with comic horror at the thought that anything in the preface can be construed into a comparison between works like Thomson and Tait, Clerk-Maxwell and W. K. Clifford, with such elementary picture-books as Deschanel and Ganot. I do not indeed share Prof. Tait's contempt for these "foreign" books; a student will find in them details, about (say) barometers or air-pumps, for which he may search the other works mentioned in vain. I did not urge students to read Thomson and Tait, because to those who can the advice is superfluous; to those who cannot it is disheartening. I did, and do, recommend such junior students as we get at provincial colleges to read easy works on Physics—not always because they contain a profound and satisfactory statement of principles, for how few of them do, but because they explain a multitude of details and experimental developments with which it was unwise to encumber a little book dealing mainly with vital principles, and aiming at being, in its humble way, an introduction to the classics of the science.

My book is primarily intended as milk for babes; and while it would be cruel to tell a baby to look at the sun, it is possible to direct his attention to a gas-light with some pleasure and satisfaction.

OLIVER LODGE

University College, Liverpool, November 13

## The Resting Position of the Oyster—A Correction

IN a late number of NATURE (vol. xxxii. p. 597) Mr. J. T. Cunningham makes the extraordinary announcement that Woodward, Jeffrey, and Huxley were wrong in asserting that the oyster rests on the left side. I am in a position to state with positive certainty that it is invariably the left valve of the fry of the oyster which becomes affixed to a foreign object. I have examined thousands of very young adherent spat ranging in size from 1-90th of an inch to 2 inches in diameter, and have never found an exception to this rule. Besides the positive statements to the same effect made by Huxley and others, I would refer the reader to a brief paper by myself entitled "On the Mode of Fixation of the Fry of the Oyster" (*Bull.* U.S. Fish Commission, vol. ii., 1882, pp. 383-387); but I would caution the reader that Figs. 3 to 8 were reversed through an unfortunate oversight, as the apices of the umbos of all the larval shells figured on p. 387 should be directed to the left instead of to the right side. This blunder of the artist is pointed out in the explanation to plate 75, where the figures from the above-cited notice are reproduced in my paper entitled "A Sketch of the Life-History of the Oyster," forming Appendix II. to "A Review of the Fossil Ostreidæ of North America," by Charles A. White, M.D., and Prof. Angelo Heilprin. In another paper of mine, "The Metamorphosis and Post-Larval Development of the Oyster," Rep. U.S. Fish Commissioner, Part 10, for 1882, p. 784, Fig. 2 shows the larval shell, L, of the young spat in normal position, with the umbo directed to the left. This figure may be compared with advan-

tage in respect to the points raised here with the figure of the external anatomy of the adult on plate 73 in my "Sketch of the Life-History of the Oyster," already cited.

Mr. Cunningham's inference that the left valve, usually regarded as the lower one, is really the upper, because he finds worm-tubes and hydroids most abundant on the convex or left valve, is founded upon an imperfect acquaintance with the habits of the oyster. For, if living oysters are thrown into the water they will invariably fall upon the bottom with the left valve downward. If dead oyster-shells—free valves—be similarly thrown into the water, they will invariably fall with the hollow side up, and the convex one down. And furthermore, both living and dead shells remain in just the position in which they fall. Dead shells sown as cultch, or collectors, fall in such a position, and most of the spat is "caught" on the exposed parts of the under surface of such shells, whereas little is found on the upper surface. The reason for this is that the sediment which is deposited on the upper surfaces, asphyxiates the young oyster-fry and the other larvæ which affix themselves before they can become established and strong enough to resist its effects. The affixed organisms on the exposed inclined under surfaces of the shells, are, on the other hand, protected from the accumulation of sediment.

It is also well known that the right valve of the oyster is always the most deeply pigmented, while the lower or left one is paler. This is always the case when oysters lie almost flat on the bottom. When crowded together on the natural banks in a vertical position, there is less difference between the colours of the valves. This difference is obviously due to some influence exerted by the position of the aspects of the body of the animal in respect to light, the same as in land and aquatic animals generally. I would conclude, for this last reason alone, that the right valve of the oyster is normally always uppermost, were it not for the fact that I have observed all the stages of transition from the spat to the adult condition in confirmation of such a conclusion. It is true that many young oysters have the right valve looking down when allowed to grow upon cultch or shells which have been sown upon the bottom to favour the collection of the spat, but that circumstance by no means subverts the conclusions of such cautious and careful observers as Brooks, Woodward, Jeffrey, Huxley, Horst, and others.

JOHN A. RYDER

Smithsonian Institution, Washington, U.S.A., November 11

### The Rotation Period of Mars

ONE or two points in Prof. Bakhuysen's investigation of the rotation period of Mars require correction:—

First, my determination of the period, as finally corrected, was 24h. 37m. 22·72s., correct within 0·02s. The correction arose from the detection of a small clerical error. My final result was deduced from a comparison of observations by myself in 1873, with observations by Kaiser in 1864, Madler in 1830-1837, Sir W. Herschel in the last quarter of the eighteenth century, Huyghens and Hooke in 1666. I have since used the best observations during the oppositions of 1881 and 1883, without finding any occasion for changing my result even by one-hundredth part of a second, though I place no reliance on the second decimal figure.

But, secondly, Prof. Bakhuysen, like Mr. Denning some time since, has taken Kaiser's result uncorrected for the clerical errors—very seriously affecting it—which I detected in 1873. Kaiser counted three days too many in comparing Hooke's observation with his own: one day through a mistake in correcting for change of style, and two days (apparently) from counting the years 1700 and 1800 as leap-years. His thus taking three days too many of terrestrial time had the effect—since three corresponding Martian rotations were taken in—of introducing a deficiency amounting to three times the excess of a Martian over a terrestrial day, that is, 3 × 37m. 22·7s., or 67,281 tenths of a second. This, divided by the total number of Martian rotations, about 88,900, gives as a correction about 0·077s. to be added to both Kaiser's estimates, making them respectively 24h. 37m. 22·697s. and 24h. 37m. 22·668s., the mean of which, 24h. 37m. 22·6825s., is practically the same as the value I assigned, viz. 24h. 37m. 22·7s.

I think it probable that Schmidt (and perhaps Prof. Bakhuysen, too) followed Kaiser so far as the error of three days was concerned. It would naturally be taken for granted that this part of Kaiser's work was free from error. If I had not been determined to find out where and how Kaiser's calculations differed from my own, I should not have found out his mistake, for certainly one would not expect to find two large errors in a work perfectly free from small ones. But so it was. I may remark that Prof. Newcomb, of Washington, went through my calculation, finding it correct, and that Kaiser really had made the mistake I indicated.

As this correction re-established what Kaiser had doubted, the accuracy of Hooke's observations, and of my own interpretation of them, Prof. Bakhuysen's correction is scarcely admissible. For a difference of 0·06s., multiplied by 88,900 for the Martian rotations between Hooke and Kaiser in 1873, gives a total discrepancy of an hour and a half, nearly all of which must be assigned to Hooke's observations and Huyghens' (which I brought into agreement with Hooke's by correcting Kaiser's one-day error for change of style).

RICHD. A. PROCTOR

5, Montague Street, Russell Square, W.C., November 23

### Beloit College Observatory

MY attention has been called to a paragraph in NATURE (vol. xxxii. p. 514), which, quoting from *Science*, speaks of "the Astronomical Observatory of Beloit College as closed for lack of funds." It is not strange that you express surprise at this announcement. Permit me to say that it is positively untrue. So far as I can learn, the only authority for it is a strange and entirely unwarranted statement from our late Director. Mr. Tatlock's connection with our Observatory closed on July 1 last. Within one week of that date Mr. Charles A. Bacon was appointed his successor, and a few weeks later he appeared and took charge. He has already proved himself competent, both as an observer and as an instructor. New arrangements are made for both meteorological and astronomical observations, and special attention will be given to solar and spectroscopic work. Though not richly endowed, our "Smith Observatory" is well equipped, and under its present direction its facilities will be made helpful to both the advancement and the diffusion of science.

A. L. CHAPIN

Beloit College, Wisconsin, October 31

## *CONFERENCE OF DELEGATES OF CORRESPONDING SOCIETIES OF THE BRITISH ASSOCIATION, HELD AT ABERDEEN*

A NEW branch of the British Association glided unobtrusively into existence at Aberdeen, under the new rules passed in the previous year: I mean the Conference of Delegates of Corresponding Societies. The Committee to whom the general arrangements connected with this new branch is intrusted are now issuing a circular to the Corresponding Societies, signed by myself as its Chairman, and by Prof. Meldola as its Secretary, in which they give an account of the proceedings at Aberdeen, with comments thereon. Much of this will be of general interest, as it helps to explain the functions of the Conference, which, as the proceedings showed, were imperfectly understood by many of the delegates themselves. The report is too long to ask you to print it in full, and on the other hand its general purport is more easily seized by leaving out details. I therefore limit myself to sending you extracts from it, with connecting-links of explanation to make them read continuously.

The Corresponding Societies Committee of the British Association beg to lay the following statement of work done at Aberdeen, with comments thereon, before the Presidents and Councils of the various Societies whose applications for enrolment as Corresponding Societies of the British Association had been granted.

The Conference of Delegates was held on Thursday, September 10, and on Tuesday, September 15, both meetings having been called at 3.15 p.m., and lasting in each case about one hour.

(Here follows a list of the various Corresponding Societies and of the attendance of their respective representatives.)

At the first meeting

The Secretary read the first report of the Corresponding Societies Committee, which had been presented to the Council and accepted by the General Committee of the British Association. Methods of procedure were then discussed, and explanations as to the functions of the Conference were given by the Chairman and Secretary in reply to questions or otherwise.

After some informal conversation, invited by the Chairman for an interchange of views, in which suggestions were made as to the nature of the work which might be taken up by Local Societies,

The Chairman explained that although individual delegates might perhaps like to take advantage of the Conference to mention informally and when time permitted, any work in which their Society was engaged, with the object of comparing views with, or obtaining assistance from, their brother delegates, it did not fall within the functions of the Conference to suggest or to initiate any scheme of local investigation. It was their function simply to consider how such schemes of the kind, as had been previously considered and adopted by the British Association, through its General Committee, could be best carried out. If any delegate desired to formally propose to the Conference any subject for local investigation, he must do so through the regular channels along which all proposals that receive the sanction of the British Association have to pass. In such cases the subject must first be brought before the Committee of the Section within whose province it lies. It is for that Sectional Committee in the first instance to discuss its merits, and if they approve of the idea they will forward it, backed with their approval, to the Committee of Recommendations, whose duty tt is to revise all such proposals, especially when they involve grants of money, and to submit them in their revised form to the General Committee, under whose sanction they become invested with the full authority of the British Association. Every proposal that has been approved by a Sectional Committee, and is concerned with local investigation, will be forwarded under the new rules by the Secretary of the Section to the Secretary of the Conference, at the same time that he forwards it to the Committee of Recommendations. The hour and day of the meetings would not admit of delaying the consideration of the proposals by the Conference until they had passed through their final stages and had received the formal sanction of the Association, but practically little or no difficulty will arise from this forestallment of their final approval, because it is a matter of experience that the deliberate approval of a Sectional Committee is rarely over-ruled on after-consideration, except it be on the grounds of finance, in which case the investigation would simply be abandoned. The real point of importance is that every proposal should pass its first and principal ordeal before a Sectional Committee before it becomes admissible as a subject of formal consideration by the Conference of Delegates. He also reminded the Conference that, in accordance with Rule 7 of the rules relating to Corresponding Societies, "The Conference may also discuss propositions bearing on the promotion of more systematic observation and plans of operation, and of greater uniformity in the mode of publishing results."

At the second meeting of the Conference the following recommendations for the appointment of Committees intrusted with local inquiries were read to the Conference:—

(1) For the purpose of defining the racial characters of the inhabitants of the British Isles. Dr. Garson explained the objects of this Committee, and invited the co-operation of the Local Societies.

(2) For the purpose of recording the position, height above the sea, lithological characters, size, and origin of the erratic blocks of England, Wales, and Ireland, reporting other matters of interest connected with the same, and taking measures for their preservation.

(3) For the purpose of investigating the circulation of the underground waters in the permeable formations of England, and the quality and quantity of the water supplied to various towns and districts from these formations.

(4) For the purpose of inquiring into the rate of erosion of the sea-coasts of England and Wales, and the influence of the artificial abstraction of shingle or other material in that action.

Mr. C. E. De Rance made brief statements explanatory of the work of each of the three foregoing Committees, and pointed out the manner in which assistance could be rendered by the Local Societies.

A letter was read from the Secretary of Section D, transmitting a recommendation that the subject of the preservation of the native plants of this country should be brought under the notice of the Local Societies, and deputing Prof. W. Hillhouse to bring this subject before the delegates present at the Conference.

In accordance with the foregoing recommendation, Prof. Hillhouse gave numerous instances of the extermination of rare plants from certain localities by dealers, to whom their habitat had become known. He stated that, having been empowered by the Sectional Committee to represent their views on this subject, he had thought it desirable to draw up the following protest:—

"We view with regret and indignation the more or less complete extirpation of many of our rarest or most interesting native plants. Recognising that this is a subject in which Local Societies of naturalists will take great interest, and can exercise especial influence, we urge upon the delegates of Corresponding Societies the importance of extending to plants a little of that protection which is already accorded by legislature to animals and prehistoric monuments, and of steadily discouraging and, where possible, of preventing any undue removal of such plants from their natural habitats; and we trust that they will bring these views under the notice of their respective Societies."

It was then arranged: (1) That the above gentlemen (or, if more convenient, the Chairman or the Secretary of the Committees they severally represent) should communicate with each of the delegates as soon as the details of their proposed investigations had been matured. (2) That each delegate should thereupon do his best to interest the members of his Society, and, if thought desirable, the Society itself, in the subject of investigation, and should send to his correspondent the names and addresses of such persons in his neighbourhood as might be likely to render willing and effectual help, so as to put him at once in direct communication with them.

It was further agreed that, with the view of making the delegates personally acquainted with one another, it was advisable to give them an opportunity of dining together at an early day during the meeting, and Prof. Meldola was authorised to make the necessary arrangements for the following year at Birmingham. Thursday was suggested as a convenient day for the dinner, but it seems better on reconsideration to adopt Wednesday, at 6. After the dinner the delegates would proceed to the places reserved for them at the opening evening meeting to hear the President's address. Particulars of the place and cost of the dinner, &c., will be posted on the notice board in the reception room.

The Corresponding Societies Committee have now to point out that, although thirty-nine Societies were admitted as Corresponding Societies, only twenty-three of them nominated delegates. Of the twenty-three delegates only eleven were present at the final meeting to hear the explanations of the gentlemen who attended for the purpose of making them, and of placing themselves in personal communication with the several delegates. The Committee feel sure that the delegates who failed to attend the Conference had not realised the character of the engagement into which they had entered, and that they must have erroneously regarded their title and privileges as purely honorary, and their duties as sinecures. The Corresponding Societies Committee desire it to be clearly understood that such is not the case, as the work intrusted to the delegates is real and important. Conspicuous notices of the times and place of meeting of the Conference had been posted in prominent positions in the reception room and in the sectional rooms, so that ignorance of the meetings could hardly be pleaded in excuse. The position of each delegate is that of a person of scientific influence in his own neighbourhood, who, by the acceptance of his title and its privileges, pledges himself to act as a friendly intermediary between those Committees of the British Association who are occupied with local investigations and the local scientific men who are known to him. It is his duty to make himself well informed of the nature of the proposed inquiries sanctioned by the British Association as personally explained by the represent-

atives of the respective Committees, and to qualify himself as far as possible for the honourable post of local correspondent. It is in return for the prospect of this very valuable assistance that the position of a member of the General Committee is granted to each delegate, and the privilege is accorded of having published in the *Reports* of the British Association a catalogue of the local investigations of the Society which he represents. Hereafter the Corresponding Societies Committee will take into consideration the advisability of not recommending for re-election those Societies whose delegates fail to attend the meetings of the Conference without adequate explanation.

These views were expressed by the Chairman at the second meeting of the Conference, and they appeared to be fully in harmony with the feelings of the delegates who were present.

The above extracts contain all that is of general importance in the circular letter. Whether or no the Conference of Delegates will grow into an important branch of the British Association remains to be seen. The rules under which it is established ought to secure it from the danger of provoking the jealousy of Local Societies by the assumption of a dictatorial attitude towards them and by interfering in their concerns: on the other hand they as surely prevent it from growing into the anomalous office of an *imperium in imperio* as regards the British Association. Consequently the success of the Conference appears wholly to depend on an abundant and continuous supply of good work being found for it to do, and on a sufficiency of zeal among the delegates to perform their duties efficiently.

FRANCIS GALTON

## DR. CARPENTER, C.B., F.R.S.

A SHORT sketch of the life and work of the eminent naturalist who has recently passed from among us will be welcome to the readers of NATURE.

William Benjamin Carpenter was born at Exeter in 1813, and was the fourth child and eldest son of Dr. Lant Carpenter, a Unitarian minister. His sister, Mary Carpenter, who died a few years since, achieved the most important work as a philanthropist, in relation to the treatment of prisoners and to questions affecting our Indian fellow-subjects, and will be remembered by future generations with no less gratitude than her brother.

In his childhood Dr. Carpenter received an excellent education, comprising both classics and the principles of physical science, at the school established by his father at Bristol, and it was his intention to adopt the profession of a civil engineer. He was, however, persuaded to accept the opportunity offered by a medical practitioner, Mr. Estlin, of Bristol, and to enter on the study of medicine as apprentice to that gentleman. Shortly after this he was sent, as companion to one of Mr. Estlin's patients, to the West Indies, and on his return from this visit he entered, at the age of twenty, the medical classes of University College, London. After passing the examinations of the College of Surgeons and the Apothecaries' Society he proceeded to Edinburgh, where he graduated as M.D. in 1839.

His graduation thesis on "The Physiological Inferences to be deduced from the Structure of the Nervous System of Invertebrated Animals" excited considerable attention, especially on account of the views which he advanced as to the reflex function of the ganglia of the ventral cord of Arthropoda.

From the first Dr. Carpenter's work showed the tendency of his mind to seek for large generalisations and the development of philosophical principles. He was a natural philosopher in the widest sense of the term—one who was equally familiar with the fundamental doctrines of physics and with the phenomena of the concrete sciences of astronomy, geology, and biology. It was his aim, by the use of the widest range of knowledge of the facts of Nature, to arrive at a general conception of these phenomena as the outcome of uniform and all-pervading laws. His interest in the study of living things was not therefore primarily that of the artist and poet so much as that of the philosopher, and it is remarkable that this interest should have carried him, as it did, into minute and elaborate investigations of form and structure. Although some of his scientific memoirs are among the most beautifully illustrated works which have been published by any naturalist, yet it is noteworthy that he himself was not a draughtsman, but invariably employed highly skilled artists to prepare his illustrations for him. Yet we cannot doubt that the man who, with his dominant mental tendency to far-reaching speculations, yet gave to the world the minute and ingenious analysis of the beautiful structure of the shells of Foraminifera, had an artist's love of form, and that the part of his life's work (for it was only a part among the abundant results of his extraordinary energy) which was devoted to the sea and the investigation of some of its fascinating living contents, was thus directed by a true love of Nature in which ulterior philosophy had no share.

Two books, Dr. Carpenter has told us, exerted great influence over his mind in his student days: they were Sir John Herschel's "Discourse on the Study of Natural Philosophy" and Lyell's "Principles of Geology"—that great book to which we owe the even greater books of Charles Darwin. Taking the "Principles" in some way as his model, Dr. Carpenter produced in 1839 his first systematic work, under the title "Principles of General and Comparative Physiology, intended as an Introduction to the Study of Human Physiology and as a Guide to the Philosophical Pursuit of Natural History." Admirable as was the execution of this work in many ways, its great merit lay in the conception of its scope. It was in fact the first attempt to recognise and lay down the lines of a science of "Biology" in an educational form. Carpenter's "Comparative Physiology" is the general or elementary "Biology" of the present day—traced necessarily upon the less secure foundations which the era of its production permitted, viz. one year only subsequent to the date of Schwann's immortal "Microscopical Researches."

For five years Dr. Carpenter remained in Bristol, commencing medical practice and marrying in 1840; but in 1844, feeling a distaste for the profession of medicine, he removed to London in order to devote himself entirely to a literary and scientific career. He was encouraged to take this step by the success which his "Comparative Physiology" obtained, a second edition having been called for within two years of the publication of the first. He was appointed Fullerian Professor of Physiology in the Royal Institution during his first year in London, and Professor and Lecturer at University College and at the London Hospital, whilst he was also elected a Fellow of the Royal Society.

In 1851 Dr. Carpenter became Principal of University Hall, the residential institution attached to University College, where he remained until 1859. During this period he remodelled his treatise on Physiology, issuing the more general biological portion as "Comparative Physiology," whilst that portion dealing with the special physiology of man and the higher animals appeared as his well-known "Human Physiology," which subsequently ran through many editions. The "Human Physiology" is remarkable in the first place for the chapters on the physiology of the nervous system, and especially for the theories enunciated with regard to the relations of mind and brain, and the attempt to assign particular activities to particular portions of the cerebral structure. In arriving at his conclusions Dr. Carpenter had to depend on arguments drawn from the facts of comparative anatomy and of diseased or abnormal conditions in man. There is no doubt at the present day of the acuteness which he displayed in his treatment of the subject, and of the truth in a general way of the results which he formulated. Experiment and a wider range of observation have to some extent corrected—but on the

whole rather extended and confirmed—the doctrines of the early editions of the "Human Physiology" in regard to this subject, so that he was able only a few years since to separate this portion of the work and issue it as a separate book, the "Mental Physiology," in which is contained by far the most complete, consistent, and readable account of the phenomena of mind, and their relation to the actual structure of the brain, which exists. Such topics as Instinct, Mesmerism, Somnambulism, Unconscious Cerebration (his own phrase), &c., are discussed in a masterly way, and with an abundance of illustration and knowledge which renders the work one of the greatest value even to those who may differ there and there from its theoretical conclusions.

About the period of his removal to London Dr. Carpenter began to occupy himself with the minute study of the structure of the calcareous shells of the Mollusca—being led thereto by a desire to compare the results of the operation of living matter upon distinctly mineral compounds (such as carbonate of lime), by way of comparison and in illustration of the rapidly accumulating knowledge of cell-structure in the softer parts of living things. This study, which resulted directly in some valuable contributions to our knowledge of the structure of shells, shown by these researches to be far more complex than had hitherto been supposed, led on the one hand to Dr. Carpenter's permanent identification with the pursuit of research with the microscope, and on the other hand to those admirable investigations of the structure and law of growth of the shells of the minute Protozoic Foraminifera which constitute his most weighty contribution to the special literature of science. His microscopic studies bore fruit in the publication of "The Microscope and its Revelations," the sixth edition of which was issued in 1881. The studies on the shells of Foraminifera were continued throughout his life, being published in four memoirs in the *Philosophical Transactions*, and in a richly illustrated monograph produced by the Ray Society in 1862, whilst the last of his memoirs in the *Philosophical Transactions* was that on Orbitolites bearing date so late as 1882. It was on this subject that Dr. Carpenter was busy at the time of his death, having during the past few years accumulated a wealth of material and drawings in support of his contention that the *Eozoon canadense* discovered by Logan in the Laurentian rocks of Canada exhibits the distinctive structure of the shell-substance of the higher Foraminifera. There is reason to hope that the memoir which he had nearly completed on this subject may yet be brought by his son, Dr. Herbert Carpenter, into a finished form and published.

At the age of forty (1853), what with his larger and smaller books, his original researches, his lectures on medical jurisprudence at University College, and numerous popular lectures on scientific topics, Dr. Carpenter's life was unusually laborious and productive.

In 1856 he was appointed Registrar of the University of London, and for twenty-three years administered the onerous duties of that office in such a way as to contribute in no small degree to the success of the University, and above all to the maintenance of the high character of its degrees and the ample recognition of the study of natural science for which the University is now distinguished.

He was able now to give a larger amount of time than formerly to his original investigations, and, in his summer holidays at Arran and elsewhere, commenced, amongst other studies, those researches on the structure and development of the beautiful little feather-star, which were from time to time published in the *Philosophical Transactions*, and led to his association with Wyville Thomson, and thus to the deep-sea explorations of the *Lightning*, and subsequently of the *Challenger*.

Carpenter's memoirs on Comatula give a very full and beautifully illustrated account of the structure of the skeleton of the feather-star, but for many years the view which he entertained with regard to the nature of the axial cord which runs through the segments of the arm-skeleton of that animal was regarded by all other observers (with scarcely an exception) as erroneous. Dr. Carpenter considered these cords as nerve-cords, and after his retirement from official life he made a special visit (only five years or so ago) to the marine laboratory erected by Dr. Dohrn at Naples, in order to test his views by the repetition, on an extensive scale, of experiments which had already appeared convincing to his mind. These experiments, and others since carried out by younger naturalists, have at length fairly established the view for the truth of which the veteran observer had long contended.

The deep-sea explorations which Dr. Carpenter, assisted by Prof. Wyville Thomson, arranged, and for which he succeeded in obtaining the aid of ships of the Royal Navy, were designed not merely to search for organisms in the great depths of the ocean, but especially to study the ocean currents both deep and superficial, Dr. Carpenter having a strong desire to enter upon the explanation of the great physical phenomena presented by the ocean. He himself took part in the earlier expeditions in 1868 and subsequent years, and though unable to leave the ties which bound him to home, so as to join the long *Challenger* Expedition, yet he closely watched the results then obtained, and embodied the whole of his observations, and those reported from the *Challenger*, in some extremely suggestive and important memoirs and lectures on ocean circulation.

In 1879 he retired from the Registrarship of the University of London with a well-earned pension, and was at once chosen as a member of the Senate of that body. He now devoted himself with unabated vigour to the prosecution of his studies on Foraminifera and on Comatula, and to more theoretical matters, such as ocean-currents, and the explanation of the frauds of spirit-mediums. Though released from the duties of office, he was still a constant attendant at the Senate of the University, he rarely missed a meeting of the Royal Society or one of the annual gatherings of the British Association, and, besides undertaking the administration of the Gilchrist trust, delivered many lectures in all parts of the country himself—both independently and as an emissary of the trustees. The scheme of lectures and scholarships instituted by the Gilchrist trustees, which is effecting an important educational work in natural science among classes of society excluded from regular University teaching, is Dr. Carpenter's work. He wrote at this time in the interest of the public health some admirable articles on vaccination, as in earlier life (1849) he had from a similar point of view treated the subject of alcoholic liquors, and had urged the arguments for total abstinence. When past seventy years of age he did not shrink from a journey to the United States, where he spoke and lectured with unflagging vigour. The last public movement in which he took an active part was the foundation of the Marine Biological Association, of which he was a Vice-President, and which is about to carry out, by means of its laboratory on Plymouth Sound, a suggestion which is traceable to his own proposition for the thorough exploration and study of Milford Haven.

The abundant and noble achievements of Dr. Carpenter's public and scientific career did not pass without recognition in the form of awards and titles. He received in 1861 one of the Royal medals awarded by the Council of the Royal Society, and in 1883 the Lyell medal of the Geological Society. In 1871 he was made an honorary LL.D. of the University of Edinburgh, and in 1872 he was President of the British Association for the Advancement of Science, when it met at Brighton. In 1873 he was elected Corresponding Member of the Institute of France, and on his retirement from his official position

at the University of London in 1879 he was nominated C.B.

It is impossible to do justice to Dr. Carpenter's character as a scientific man in a few lines: here no attempt has been made to do more than indicate in something like chronological order and connection of subjects the vast amount of work which he accomplished.

Upon the present writer, whose father was his fellow-student at University College, and who has enjoyed since boyhood the privilege of his friendship, Dr. Carpenter always produced the most vivid impression of a man of indomitable energy, who had accepted as the highest duty and keenest delight of his life, the promotion, whether by advocacy or by research, of true knowledge. The tenacity and vigour with which he was wont to expound his views on such matters of research as at the time occupied his thoughts, and the importance and respect which he assigned to all genuine research, were evidences of an earnest and just nature which evoked sympathy and esteem in all men of kindred pursuits.

In reference to Dr. Carpenter's private life and tastes, the following extract from a weekly contemporary states, with the authority of a member of his own family, what might, in its absence, have been here less completely indicated. The journal to which we are thus indebted is an organ of the Unitarian Church, of which body Dr. Carpenter was, throughout life, an active and orthodox member, a fact which may or may not be brought into connection with the fact of his incomplete acceptance of the leading doctrines of Darwinism, though the latter would by no means necessarily follow from the former.

"He was well versed in literature, and turned for refreshment in hours of weariness to his favourite Scott. Political memoirs of his own time were read with the keenest relish, for he had early learned from his father, Dr. Lant Carpenter, to take a high view of a citizen's obligations, and the Bristol riots, which he had witnessed, made a life-long impression upon him. A brief sojourn in Italy called forth a susceptibility to the enjoyment of art, which was a surprise even to himself; and in music, from the time that he had taught himself as a young man to play on the organ, he found unfailing recreation. Nature, likewise, in her vaster as well as her microscopic forms, was for him full of charm and delight, and from every excursion he carried back memories which remained singularly vivid and distinct. In society his immense stores of information, his sympathetic interest in others, his thorough enjoyment of humour though he felt unable to originate it, made him a genial and ever-welcome companion, while his friends learned how strong a confidence might be placed in his faithfulness. Many young men found unexpected help and encouragement in him, and he rejoiced when he could open a way to those who were involved in the struggles through which he had himself once passed. The dominant conception of his life—as was fitting in one of Puritan descent—was that of duty. And if this sometimes took austere forms, and led him to frame expectations which others could not always satisfy, an enlarging experience mellowed his judgment and enabled him to apprehend their position from their point as well as his own. Released from the pressure and strain of earlier life, he was able to give freer play to his rich affections; and in his own family they only know what they have lost who will never again on earth feel his support as husband and father, brother, and friend."

E. RAY LANKESTER

## *WALTER FLIGHT, D.Sc., F.R.S.*

THE close of this year has witnessed the termination of another bright and promising life, ended all too soon for the hopes and expectations of his many friends.

Walter Flight was the son of William P. Flight, of Winchester, in which city he was born on January 21, 1841. He was sent, after a period of pupilage at home, to Queenwood College, Hampshire, in the days when George Edmondson was head master, and Tyndall and Debus were the teachers of science. From Queenwood he went to the University of Halle, where, in the laboratory of Prof. Heintz, he pursued his chemical studies during the winter session of 1863-64. During 1864 and 1865 he entered the University of Heidelberg, where, in the laboratories of the celebrated Profs. Bunsen, Kopp, and Kirchhoff, he applied himself early to acquire that thorough knowledge of the various branches of theoretical and practical chemistry, and that marked facility for overcoming experimental difficulties which characterise the practised and careful worker. From Heidelberg Flight passed to the University of Berlin, where he remained until 1867, studying and working in Prof. Hofmann's laboratory, and for a time filling the office of his Secretary and Chemical Assistant.

Returning to England in 1867, he graduated D.Sc. in the University of London, and in the following year was appointed by the Senate to the office of Assistant Examiner under Prof. Debus (his former teacher at Queenwood). On September 5, 1867, Dr. Flight was appointed an Assistant in the Mineralogical Department of the British Museum. Here, under the direction of Prof. Maskelyne, the Keeper of Mineralogy, he commenced a series of researches into the chemical composition of the mineral constituents of meteorites and the occluded gases they contain. Many of the methods by which he carried out these investigations were originated by him in the course of the research, and displayed in a remarkable degree his skill and ingenuity in chemical manipulation.

He was shortly after this date appointed Examiner in Chemistry and Physics at the Royal Military Academy, Woolwich, and in 1876 Examiner to the Royal Military Academy, Cheltenham.

For several years Dr. Flight served on the Luminous Meteors Committee of the British Association, to which he lent much valuable assistance.

Between the years 1864 and 1883 he was author of twenty-one original papers, including "A Chapter in the History of Meteorites," which appeared in a succession of twenty-three articles in the *Geological Magazine* in 1875, 1882, and 1883. He was also joint author or contributor of results to many other papers, chiefly on the chemical composition of minerals. His important memoir on the Cranbourne, Rowton, and Middlesbrough meteorites was read before the Royal Society in 1882, and he was elected a Fellow in the following year.

In 1884 he was seized by illness which prostrated his mental powers, and rendered it needful for him to resign his appointment in the British Museum in June last, and notwithstanding every care which medical skill or affection of friends could devise, he succumbed on November 4, leaving a wife and three young children to deplore his early loss.

## *ON RADIATION OF HEAT FROM THE SAME SURFACE AT DIFFERENT TEMPERATURES*

FOR some time past I have been engaged in experimenting on the radiation of heat from the surfaces of wires in air and in vacuum, and I have obtained results which have been partially communicated in papers to the Royal Society (1884) and to the British Association at its last two meetings. I am at present preparing to publish further determinations of emissivities in absolute measure. In the meantime, however, I have obtained a result of some importance which may be of interest to the readers of NATURE.

Stefan has given a law, which is well known, as to the

dependence on temperature of radiation of heat from the same surface—namely, that the radiation is in proportion to the fourth power of the absolute temperature. This law was deduced originally from certain experiments of Prof. Tyndall on radiation from a heated platinum spiral (*Pogg. Ann.*, Bd. cxxiv., quoted by Wüllner, "Exp. Physik," Bd. iii. 1885). The law has been also considered by other writers, including Christiansen (*Ann. der Physik und Chemie*, Bd. xix. 1883), and they have adduced experiments which seemed to them to confirm it.

The method of experimenting which I employ makes it easy to test the truth of such a law, and in fact to find the law, and I have accordingly made the necessary calculations for the former purpose.

In my experiments a current of known strength is passed through the wire under examination, and the increase in the resistance of the wire due to heating by the current is determined while the current is passing through it. When the temperature of the wire has become constant, the heat generated by the current (which can be calculated in absolute measure) must be equal to that emitted by the surface of the wire *plus* that lost at the ends of the wire by conduction. The temperature of the wire at the moment is also ascertained from its resistance (as was done by Siemens in his experiments on resistance of platinum wire at different temperatures, *Proc.R.S.*, vol. xix. p. 443). I have recently been experimenting on platinum wires in a high vacuum down to about 1/20 **M**. (one twenty-millionth of an atmosphere), as was described to the British Association at its meeting at Aberdeen.

The results quoted in Table I. below were obtained with a straight platinum wire about half a metre long, 0·04 cm. in diameter. It was contained in a glass tube about 0·6 cm. in internal diameter, and was sealed into the tube at the two ends, the exhaustion being made by a small side tube. The exhaustion at the time of the experiment, as measured by a McLeod gauge, was 1/15 **M**. The temperature of the room during the experiment was 15° C.

The following two tables show the results of the experiment, and also a comparison of these results with the increase of emissivity with absolute temperature calculated according to Stefan's supposed law. Four cases have been taken which are numbered in the first column of each table. For these the current, C, and the resistance of the platinum wire, R, as found by experiment, are given in the second and third columns of Table I. The energy lost by the wire, $C^2R$, called $e$ in Table II., and the estimated temperature Centigrade are given in the fourth and fifth columns of Table I. The temperature of the surroundings at the time of the experiment was 15° C. In the second table, the second, third, and fourth columns show the absolute temperatures of the wire and surroundings, and the energy lost, $e$, or $C^2R$. Column 5 shows the ratios of the energy lost in the several cases to that lost in Case 1, taken as unity. According to Stefan's law the heat emitted from the wire ought to be given by

$$W = A(S^4 - T^4),$$

where S is the absolute temperature of the wire, and T that of the surroundings. Hence if $S_1$, $T_1$ denote those temperatures in Case No. 1, and if the heat emitted in this case be taken as unity, the heat emitted with any other temperatures, S and T, would be

$$\frac{S^4 - T^4}{S_1^4 - T_1^4}.$$

This ratio, for the temperatures of the several cases, is given in the sixth column of Table II.; and it will be seen by comparison with Column 5 of that table that the increase of loss of heat with increase of temperature does not follow any such exceedingly rapid law.

TABLE I.—*Results of Experiment*

| Case | Current C | Resistance R | Energy emitted $C^2R$ | Temperature, Centigrade ° | Condition of wire |
|---|---|---|---|---|---|
| 1 | 1 × 0·169 | 1·087 | 1·087 | 25 | |
| 2 | 2·2 × ·169 | 1·371 | 6·636 | 110 | |
| 3 | 6 × ·169 | 2·17 | 78·12 | 525* | Wire perceptibly red in the dark |
| 4 | 6·5 × ·169 | 2·32 | 98·06 | 550 | Wire distinctly red hot |

* Temperature 525° taken according to Draper's estimate of temperature of a body just visible in the dark.

TABLE II.—*Comparison of Experimental Results with Calculation in accordance with Stefan's Law*

| Case | Absolute temperature of wire (S) | Absolute temperature of surroundings (T) | Energy emitted ($e$) | Ratio $e/e_1$ | Ratio $\frac{S^4 - T^4}{S_1^4 - T_1^4}$ |
|---|---|---|---|---|---|
| 1 | 298 | 288 | 1·087 | 1 | 1 |
| 2 | 383 | ,, | 6·636 | 6·1 | 16 |
| 3 | 798 | ,, | 78·12 | 71·9 | 438·8 |
| 4 | 823 | ,, | 98·0 | 90·2 | 499·8 |

A comparison between the last two columns shows the enormous discrepancy between the results calculated from Stefan's law and those obtained by experiment.

I am now waiting for the use of a secondary battery, which I expect to have in a very short time, to determine the ratio between the energy lost at dull red heat, say 550° C., and that lost at bright white heat (1200° C. according to Draper), for the case of an incandescent lamp. Already, however, we know enough of the behaviour of incandescent lamps—for example, in the case of an eight-horse-power gas-engine, developing five-horse-power of electric energy, and feeding 50 sixteen-candle-power lamps—to be able to say that it does not require ten times as much work to keep the lamps at white heat as it does to keep them at dull red heat.

November 16 J. T. BOTTOMLEY

## ELLIPTIC SPACE

ELLIPTIC geometry is more general than ordinary geometry. It refers to a three-dimensional space of a more general type than ordinary space. The ordinary mathematics supposes a more or less plausible assumption or axiom which reduces elliptic space to a special type. The present little paper is intended to illustrate the unartificial character of the elliptic geometry and to indicate the analytical nature of the axiom which the Euclidian geometry requires us to introduce. We investigate the *measurement of distance* on which the theory of elliptic space chiefly depends.

It is requisite to observe carefully the definitions which are made, and to refrain from the introduction of any notions not explicitly conveyed by the definition. Let us consider a "point" whose co-ordinates are $x_1, x_2, x_3, x_4$. It is not necessary to think of these co-ordinates as related to any geometrical scaffolding of tetrahedra or the like. It is in fact desirable to attach no geometrical import to the words, and merely to think of the word "point" as implying the four magnitudes just written. A second "point," $y$, will be similarly denoted by $y_1$ $y_2$, $y_3$, $y_4$, and we *define* that the point $x$ is distinct from $y$, unless in the case where

$$\frac{x_1}{y_1} = \frac{x_2}{y_2} = \frac{x_3}{y_3} = \frac{x_4}{y_4}.$$

If $\lambda$ be a numerical magnitude

$$x_1 + \lambda y_1,\ x_2 + \lambda y_2,\ x_3 + \lambda y_3,\ x_4 + \lambda y_4$$

will also denote a point, and then, it being assumed that $x$ and $y$ are distinct, we have a multitude of points corre-

sponding to the various values of $\lambda$. This series we call a "straight line." But we here make no implication of any geometrical character attached to the line. It is merely a collocation of points, where each point is a group of four symbols and nothing more.

Each point on the line is thus correlated with a specific value of the numerical magnitude $\lambda$, and thus if we have two points we may refer to them as the points $\lambda$ and $\mu$ respectively.

As we are free from any geometrical meaning of our symbols, we can only introduce the expression "distance between two points" by defining precisely what is meant. The distance will be a function of $\lambda$ and $\mu$, whose form is to be decided by the properties which we desire to attribute to it. We may therefore select certain laws which we desire this function shall obey, and then discover what function will satisfy the conditions necessary.

We may take a hint from our familiar geometry as to the conditions to be imposed upon the distance function. If $A$, $B$, $C$ be three points upon a straight line, then there is no more fundamental notion of distance than that implied in the equation

$$AB + BC = AC.$$

We shall accordingly insist that our distance function shall be obedient to this law (which we may call Law I.). If, therefore, $\lambda$, $\mu$, $\nu$ be three points upon our straight line, and if $f(\lambda, \mu)$ denote the distance from $\lambda$ to $\mu$, then we find

$$f(\lambda, \mu) + f(\mu, \nu) = f(\lambda, \nu),$$

and as $\mu$ must disappear from this equation we have

$$f(\lambda, \mu) = \phi(\lambda) - \phi(\mu).$$

The first step in the construction of an appropriate distance function has thus been taken, but we have still a wide range of indeterminateness, for $\phi(\lambda)$ may of course be any conceivable function of $\lambda$. It will therefore be competent for us to select some additional law and to insist upon obedience to it also.

Again we revert to our familiar geometry for a suggestion. In that geometry it is assuredly obvious that the distance between two points cannot be zero unless the two points are coincident. Trite as this condition may appear, it is yet sufficient to clear every trace of indeterminateness from the form of $\phi$: we shall term this Law II.

Combining Laws I. and II. it will be easy to show that if $P$ be a point on the line then there can only be one point, $Q$, on the line at a given distance from $P$, for, suppose that there was a second point, $Q'$, then we have, by Law I.,

$$PQ + QQ' = PQ';$$

but if $PQ$ be equal to $PQ'$, then

$$QQ' = 0,$$

from which, by Law II., we see that $Q$ and $Q'$ must be identical.

If the point $P$ be defined by $\lambda$, and the point $Q$ at a given distance therefrom be defined by $\mu$, then the relation between $\lambda$ and $\mu$ must be of the one-to-one type. The distance given, we must therefore have some equation of the form

$$A\lambda\mu + B\lambda + C\mu + D = 0.$$

Any constant values for $A$, $B$, $C$, $D$ will be consistent with the conditions, but we can without loss of generality simplify this equation. If we make $\lambda = \mu$ we obtain the quadratic

$$A\lambda^2 + (B + C)\lambda + D = 0.$$

We thus see that there are in general two critical points on the line corresponding to the roots of this equation. If we choose these two points for $x$ and $y$, which is of course possible without sacrifice of generality, the roots of this equation should be 0 and $\infty$, or in other words the constants $A$ and $D$ must be each zero. We thus see that by an appropriate choice of the fundamental points the relation between $\lambda$ and $\mu$ assumes the simple type

$$B\lambda + C\mu = 0,$$

or, finally,

$$\lambda = h\mu,$$

in which $h$ is a function of the particular distance between $\lambda$ and $\mu$.

We have, however, seen that the distance is also to be expressed in the form

$$\phi(\lambda) - \phi(\mu).$$

This must therefore be a function of $h$, that is, of $\lambda \div \mu$, and thus we have

$$\phi(\lambda) - \phi(\mu) = F\left(\frac{\lambda}{\mu}\right).$$

From this equation the particular value of the distance has disappeared. It must therefore be true for all values of $\lambda$ and all values of $\mu$. It must remain true if differentiated either with respect to $\lambda$ or $\mu$. We therefore have

$$\phi'(\lambda) = \frac{1}{\mu} F'\left(\frac{\lambda}{\mu}\right)$$

$$-\phi'\mu = -\frac{\lambda}{\mu^2} F'\left(\frac{\lambda}{\mu}\right),$$

whence

$$\lambda\phi'(\lambda) = \mu\phi'(\mu),$$

but as $\lambda$ and $\mu$ are independent this requires

$$\phi'(\lambda) = \frac{H}{\lambda},$$

or

$$\phi(\lambda) = H \log \lambda,$$

whence finally we see that the distance between the two points $\lambda$ and $\mu$ is

$$H \log \frac{\lambda}{\mu},$$

where $H$ is a constant.

There seems nothing arbitrary in this process. We have set out with the two laws I. and II., and we have without any other assumption been conducted to the logarithmic conception of distance which lies at the foundation of the elliptic geometry. We might almost be tempted to ask how any other conception of distance can be reasonable. The two laws assumed are obviously true on any intelligible conception of distance, and yet they conduct to the logarithmic expression and apparently to nothing else.

It remains to show where the assumption made in ordinary geometry comes in. Hitherto we have not restricted the generality of the constants $A$, $B$, $C$, $D$ which enter into the equation between $\lambda$ and $\mu$. Euclid, however, demands that the expression

$$(B + C)^2 - 4AC$$

shall be equal to zero. This has the effect of rendering the quadratic equation a perfect square. The logarithmic theory is accordingly evanescent, and we have to resort to the specialised conception of ordinary distance.

ROBERT S. BALL

## NOTES

THE Council of the Royal Society at their last meeting awarded the Copley Medal to Auguste Kekulé, of Bonn (For. Mem. R.S.), for his researches in organic chemistry, and the Davy Medal to Jean Servais Stas, of Brussels (For. Mem. R.S.), for his researches on the atomic weights. At the same meeting, Prof. D. E. Hughes, F.R.S., and Prof. E. Ray Lankester, F.R.S., were nominated for the Royal Medals—the former eminent for his electric researches, and the latter for his services to embryology and animal morphology. Her Majesty has since signified her approval of these nominations.

THE anniversary meeting and annual dinner of the Royal Society will take place on Monday next—St. Andrew's Day.

THE session of the Society of Arts was commenced on Wednesday last by a most important address by the President, Sir F. Abel, on Appliances used in Mines. We shall give this on a subsequent occasion.

SIR JOSEPH HOOKER, we learn, retires, after a tenure of twenty years, from the Directorship of Kew Gardens on the 30th of the present month.

THE Savilian Professor of Geometry, J. J. Sylvester, M.A., Hon. D.C.L., proposes to deliver a public lecture on Saturday, December 12, at 4.45 p.m., in the Mathematical Lecture Room in the University Museum, Oxford, "On a General Theory of the Necessary Singularities of Curves of Unspecified Order." The lecture, although presupposing some elementary knowledge of modern algebra, will not go into details of calculation, but will have for its principal object to bring to light the existence of a new world of algebraical forms, co-ordinate in extent and parallel in character, genesis, and laws of association with those which occur in the theory of invariants.

WE hear with regret that there is a possibility of the *Zoological Record* being discontinued after the close of the next (the 21st) annual volume, unless additional support be received from those most intimately concerned in the welfare of this useful and (to zoologists) indispensable *résumé* of the work done in each year. It will be a standing disgrace to British, Colonial, and American zoologists, if they allow the *Record* to lapse on attaining its majority. Those who have worked with it cannot but acknowledge the aid it has afforded them; those who work without it run the risk of finding themselves anticipated. There are probably many local societies, public libraries, institutions, and private individuals that have not yet supported it, but should do so. The *Zoological Record* Association consists of members and subscribers. Members render themselves liable to the extent of 5*l.*, and on the exhaustion of this sum can withdraw or renew their membership. They receive the annual volume, and the average cost to them has at present amounted to about 24*s.* Subscribers pay annually 1*l.*, for which they receive the volume, and incur no further liability. All those who are interested in the continuance of our *Zoological Record*, and who are not already amongst its supporters, should lose no time in communicating with the Secretary of the *Zoological Record* Association, Mr. H. T. Stainton, F.R.S., Mountsfield, Lewisham, London, S.E.

THE Elizabeth Thompson Science Fund, which has been established by Mrs. Elizabeth Thompson, of Stamford, Connecticut, "for the advancement and prosecution of scientific research in its broadest sense," now amounts to $25,000. As the income is already available, the trustees desire to receive applications for appropriations in aid of scientific work. This endowment is not for the benefit of any one department of science, but it is the intention of the trustees to give the preference to those investigations, *not already otherwise provided for*, which have for their object the advancement of human knowledge, or the benefit of mankind in general, rather than to researches directed to the solution of questions of merely local importance. Applications for assistance from this fund should be accompanied by a full statement of the nature of the investigation, of the conditions under which it is to be prosecuted, and of the manner in which the appropriation asked for is to be expended. The applications should be forwarded to the Secretary of the Board of Trustees, Dr. C. S. Minot, 25, Mount Vernon Street, Boston, Mass., U.S.A. The first grant will probably be made early in January, 1886.

LA Société de Physique et d'Histoire naturelle de Genève offers a prize of 500 francs for the best unpublished monograph on a class or family of plants. The prize was founded by A. P. de Candolle. Manuscripts may be written in Latin, French, German (in Roman letters), English, or Italian, and should be sent in to the President of the Society before October 1, 1889, to the Athenæum, Geneva. Members of the Society are not permitted to compete, and the prize may be reduced, or not awarded at all, in the event of the essays being insufficient, or not conforming to these rules. The Society hope to be able to give the successful monograph a place in their *Transactions*, should that mode of publication be agreeable to the author.

TELEGRAMS from Madrid state that earthquake shocks have again occurred at Velez Malaga, on the coast of the province of Malaga. There appears also to be some seismic movement on the opposite African coast, producing landslips of considerable magnitude close to the Mediterranean, while the bed of the sea at the points affected is reported to have sensibly risen. There have also been sharp shocks of earthquake in Andalusia, especially at Alhama, which suffered so much last year.

DR. FOREL writes that the following shocks of earthquake have been observed in Western Switzerland:—November 15, 2h. 15m. a.m., at Sion, Gryon, Ollon, or the same region which was affected on September 26 last; November 18, 9h. 25m. p.m., Chevroux, south-east bank of Lake Neuchâtel; November 20, 5h. 45m. a.m., at Gondo, on the south face of the Simplon.

SEVERAL great earthquake waves from the Pacific were observed at San Francisco on November 19 between 1 and 8 o'clock p.m. at intervals of thirty-five minutes.

BRIGADE-SURGEON AITCHISON, the naturalist with the Afghan Boundary Commission, arrived in England on the 23rd inst. He brought his numerous collections with him as far as Batoum, and there shipped them on an English steamer for London. He has succeeded in obtaining a very fine specimen of a tiger from Turkestan, which, if it should reach England alive, will be unique of its kind, as no living specimen of this animal from those districts has as yet been brought to Europe.

CAPT. MANGIN, the inventor of the system of optical telegraphy as now practised in the French Army, has died suddenly from an attack of apoplexy at the early age of forty-five.

THE committee for erecting a statue in commemoration of the late Dr. Broca has opened a public competition for this monument.

THE French Minister of War has granted new credits to the Meudon aëronauts for the construction of a larger balloon. Workmen are enlarging the shed for building the apparatus.

M. MENIER, the well-known electrical engineer and contractor, has purchased a large property, rue de Chateaud'un (Paris), and is rebuilding it on a new system. He will sell electric light to all the lodgers in the house at a reasonable rate. It is the first time this speculation has ever been tried in Paris.

WE understand that the Science and Art Department have given their sanction to the exhibits from the Buckland Museum Collection being retained by the South Kensington Aquarium authorities until the close of the Indian and Colonial Exhibition next year. A better position for them could not be found, more especially as the casts of fish hung upon the walls are in *bon accord* with the living specimens in the tanks.

THE Norwegian Forest Association, started in 1881, is making very good progress. At present there are about 250 members. The Association's journal for the current year, embracing some 300 pages, contains a number of important papers by the most eminent Norwegian writers on the subject of forests and forest culture. A meeting for the discussion of important subjects takes place annually. The question of preserving the old and cultivating new forests appears to be coming more and more to the front in Scandinavia, where the Government has now established several schools with plantations for the cultivation of young plants. In Sweden the children of the rural Board-

schools are often employed on fine days in planting out young trees. Thus during last summer some thousand acres have been planted in a single parish alone. Of late years private individuals too have done a great deal to retrieve the deforestation which has been going on by planting new trees. In one single parish in Norway, for instance, a proprietor has planted on waste land no less than a quarter of a million of spruce, fir, and larch trees, all obtained from the Government nursery. The price of the young plants is one farthing, and only 10 per cent. of the plants die. Afrer thirty years each is valued at 7*d.* in the ground. These are of course valuations in a country where both labour and timber are cheap.

WE learn that Dr. J. G. Garson has just been elected a Corresponding Member of the Anthropological Society of Paris.

As a memorial to the late Sir Titus Salt, and in recognition of his benefactions to Saltaire, the Governors of the Salt Schools have decided to build a new Science and Art School, costing about 6000*l.* The building will be completely finished by May 15, on which day will be opened an important exhibition on the lines of the late International Inventions Exhibition. For this purpose the present buildings and a field of six acres will be utilised. The arrangement and supervision of the lighting and other electrical work have been intrusted to Messrs. Woodhouse and Rawson, of London.

IN the last number of the *Bulletin* of the American Geographical Society, Mr. Ernest Ingersoll publishes a paper on the manner in which the settlement of North America has affected its wild animals. He takes in succession the customary divisions of animal life—mammals, birds, reptiles, fishes, and the almost countless invertebrates, and shows how far these prevailed geographically in historical times, and how they have now either disappeared altogether, or been driven northwards into the Canadian forests, or, in the case of fish, away from the coasts. Mr. Ingersoll thus ranges over the whole animal kingdom, and in every department he has to record destruction—in many cases wanton and useless—and disappearance. It is a most instructive and interesting paper.

THE Sanitary Institute of Great Britain has just completed the preparation of a volume which will be of great interest to the statistical world, containing selections from the reports and writings of the late Dr. W. Farr. The selection of the papers and reports and the editing of this work have been undertaken by Mr. Noel A. Humphreys, of the Registrar-General's Office. The volume consists of 550 pages and is divided into six parts: (1) population, (2) marriage, (3) births, (4) deaths, (5) life tables, (6) miscellaneous. It has long been the source of much regret among students of vital statistics, and others practically interested in that branch of sanitary science, that from the form and manner of the publication of Dr. Farr's valuable papers on statistics they have not been generally available, being scattered over a long series of Blue-Books and other Reports. The object of the Institute in publishing the selection is to give those interested in the subject a ready means of studying the valuable writings and tables of that eminent statistician.

THE additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus rhesus* ♀) from India, presented by Mrs. Berry; two Black-eared Marmosets (*Hapale penicillata*) from South-East Brazil, presented by Miss L. M. Graham; two Emus (*Dromæus novæ-hollandiæ*) from Australia, presented by Lord Northesk; an Emu (*Dromæus novæ-hollandiæ*) from Australia, presented by Mr. A. Garrett Smith; a Cuvier's Podargus (*Podargus cuvieri*) from Australia, presented by Mr. Cromwell Collins; a Tawny Owl (*Syrnium aluco*), British, presented by Mr. Phillips; an Anaconda (*Eunectes murinus*) from Demerara, presented by Mr. G. H. Hawtayne, C.M.Z.S.; a Robben Island Snake (*Coronella phocarum*), a Hoary Snake (*Coronella cana*) from South Africa, presented by the Rev. G. H. R. Fisk, C.M.Z.S.

## *OUR ASTRONOMICAL COLUMN*

THE FRENCH PHOTOGRAPHS OF THE TRANSIT OF VENUS.—The measurement of the 700 photographs obtained at the various French stations during the transit of Venus, 1882, is about to be commenced. An office has been organised for the purpose, the necessary credit has been granted, and a measuring instrument, belonging to the Meudon Observatory and lent by M. Janssen, has been supplied. This will be replaced in January next by a smaller one by the same makers, MM. Brunner, Frères. The measurements, it is expected, will be completed in fifteen months.

THE ABSORPTION-SPECTRUM OF OXYGEN.—M. Janssen, continuing at the Meudon Observatory his important and difficult researches on the spectra of the gaseous constituents of the terrestrial atmosphere, has recently given (*Comptes rendus*, vol. ci. No. 14) a brief notice of the results he has obtained. The spectrum of an intensely brilliant light is viewed through a tube 60 m. in length containing oxygen, the pressure of the gas being constantly increased up to a pressure of 27 atmospheres. With the increase of pressure, dark lines or groups of lines appear. The first to appear are those groups in the red, which M. Egoroff, who was the first to observe them, considered to be the A and B of the solar spectrum. With higher pressures, and a more brilliant source of light, lines are suspected between A and B and between B and C. Lastly, with the greatest pressures three dark bands appear; one near α, one near D, but more refrangible, and one in the blue. The solar spectrum does not show any similar bands, which, therefore, can scarcely be ascribed to oxygen in the state in which it exists in our atmosphere.

THE APPARENT ENLARGEMENT OF CELESTIAL OBJECTS NEAR THE HORIZON.—M. Paul Stroobant has recently devoted a considerable amount of care to examining the cause of this well-known phenomenon. His experiences lead him to reject the theories most commonly received, that the appearance is due either to comparison with terrestrial objects, or to the "flattened arch" shape ascribed to the celestial vault. Experiments made with pairs of electric sparks in a lofty hall, showed that if the two sparks overhead were 100 mm. apart, the pair on a level with the eye, and equally distant from the observer, needed only to be 81·5 mm. apart to seem separated to a similar extent. Comparisons of various pairs of stars gave a similar result, and the following formula was found to represent the apparent size, G, of a celestial object, at any given altitude, H, when the size on the horizon was taken as 100:—

$$G = 100 - 19 \sin H.$$

Beside this relation, depending evidently on some physiological effect connected with the position of the head, M. Stroobant found that an increase in the brightness of an object caused an apparent diminution in its size, and *vice versâ.* The great apparent size of the moon at rising was therefore, he considered, largely due to its comparative faintness when near the horizon.

NOVA ANDROMEDÆ AND ITS RELATION TO THE GREAT NEBULA.—There seems to be considerable difference of opinion as to whether the new star is to be regarded as having a real physical connection with the nebula, or as being connected with it in appearance only. M. Trouvelot (*Comptes rendus*, vol. ci. No. 17) ably pleads for the latter view. Comparing the present aspect of the nebula with the chart he made of it in 1874, he finds two new stars in the central district, one being the present *Nova*, the other a star of the 13th or 14th magnitude, which precedes it by about 20s. But he believes that the nebula itself has undergone no change during the appearance of the *Nova*, the impressions to the contrary being, he thinks, due to the superior light of the star having overpowered for a time the surrounding portions of the nebula; so that the arguments founded upon these supposed or apparent changes lose their force. The 1874 chart shows some 1283 little stars, which by their feebleness and crowding present the characteristic features of the Milky Way, which indeed appears to extend somewhat beyond the nebula; and these stars also appear to become less and less numerous the farther the observer travels from the Milky Way.

But none of the stars visible upon the nebula show diffused or ill-defined borders; so that they are probably neither in the nebula nor behind it, but before it, and forming part of the Milky Way. And as the two new stars alluded to are also well and clearly defined, he argues that they also are connected with the Milky Way, and not with the nebula, which he regards as lying behind it.

THE NICE OBSERVATORY.—The great objective of 30 inches diameter, intended for the Nice Observatory, and the glass for which was supplied by M. Feil, has just been completed by the Brothers Henry, and has been placed in the hands of M. Gautier, who is constructing the equatorial, which he hopes to finish by April next.

## *ASTRONOMICAL PHENOMENA FOR THE WEEK*, 1885, *NOVEMBER* 29 *TO DECEMBER* 5

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

*At Greenwich on November* 29

Sun rises, 7h. 43m.; souths, 11h. 48m. 35·7s.; sets, 15h. 54m.; decl. on meridian, 21° 34′ S.: Sidereal Time at Sunset, 20h. 29m.

Moon (at Last Quarter) rises, 23h. 16m.*; souths, 6h. 9m.; sets, 12h. 49m.; decl. on meridian, 6° 58′ N.

| Planet | Rises h. m. | Souths h. m. | Sets h. m. | Decl. on meridian ° ′ |
|---|---|---|---|---|
| Mercury | 9 45 | 13 20 | 16 55 | 25 47 S. |
| Venus | 11 25 | 15 14 | 19 3 | 23 56 S. |
| Mars | 23 22* | 6 16 | 13 10 | 9 49 N. |
| Jupiter | 1 31 | 7 36 | 13 41 | 0 16 N. |
| Saturn | 17 49* | 1 58 | 10 7 | 22 23 N. |

* Indicates that the rising is that of the preceding day.

*Occultations of Planet and Star by the Moon*

| Dec. | Star | Mag. | Disap. h. m. | Reap. h. m. | Corresponding angles from vertex to right for inverted image ° ° |
|---|---|---|---|---|---|
| 1 | Uranus | — | 5 0 | 6 9 | 53 213 |
| 3 | κ Virginis | 4½ | 4 24 | 4 56 | 92 155 |

*Phenomena of Jupiter's Satellites*

| Nov. | h. m. | | Dec. | h. m. | |
|---|---|---|---|---|---|
| 29 | 3 23 | I. tr. ing. | 3 | 1 53 | II. ecl. disap. |
| 29 | 5 39 | I. tr. egr. | 3 | 7 0 | II. occ. reap. |
| 30 | 3 0 | I. occ. reap. | 4 | 5 9 | III. tr. ing. |
| | | | 5 | 2 8 | II. tr. egr. |
| | | | 5 | 7 3 | I. ecl. disap. |

The Occultations of Stars and Phenomena of Jupiter's Satellites are such as are visible at Greenwich.

| Nov. | h. | |
|---|---|---|
| 29 | 9 | Mars in conjunction with and 3° 23′ north of the Moon. |
| 30 | 23 | Jupiter in conjunction with and 0° 20′ north of the Moon. |
| Dec. | | |
| 1 | 0 | Mercury at greatest elongation from the Sun, 21° east. |

*Variable Stars*

| Star | R.A. h. m. s. | Decl. ° ′ | Epoch h. m. | Phase |
|---|---|---|---|---|
| U Cephei | 0 52 8 | 81 15·3 N. | Nov. 29, 3 27 | *m* |
| | | | Dec. 4, 3 7 | *m* |
| Algol | 3 0 41 | 40 30·7 N. | Nov. 29, 5 20 | *m* |
| | | | Dec. 2, 2 9 | *m* |
| | | | ,, 4, 22 58 | *m* |
| λ Tauri | 3 54 19 | 12 9·9 N. | Dec. 1, 20 9 | *m* |
| | | | ,, 5, 19 1 | *m* |
| η Aquilæ | 19 46 37 | 0 42·7 N. | Nov. 30, 2 30 | *M* |
| | | | Dec. 4, 21 30 | *m* |
| δ Cephei | 22 24 54 | 57 49·6 N. | Nov. 30, 1 0 | *m* |

*M* signifies maximum; *m* minimum.

The spectrum of R Andromedæ R.A. 0h. 17m. 58s., Decl. 37° 56′·4 N. deserves attention. The star is now approaching its maximum.

The following circular has been sent out from Lord Crawford's Observatory, Dun Echt:—"Considering the great uncertainty which envelopes the fate of Biela's comet, it seems desirable to call to mind that about midnight on the 27th inst. the earth will be in the path of the meteors seen to radiate from near γ Andromedæ on November 27, 1872. The comet's periodic time, and presumably that of the meteors being about 6·6 years, nearly two periods will have elapsed since the meteoric shower of 1872. If, therefore, the meteors are very widely distributed along the comet's orbit, there is a chance that they may again appear in considerable numbers this year. In 1892, and still more in 1905, there is a probability of a return of the display of 1872.

## *GEOGRAPHICAL NOTES*

LIEUT. GREELY has been lecturing in Scotland on the Arctic Expedition of which he was the commander. At Dundee, on Monday night, having described the retreat from Discovery Harbour, Lady Franklin Bay, he went on to speak of the results of the Expedition, which could be done only in a general manner. The temperature observations, he remarked, were mainly important in determining the fact that Grinnell Land had the lowest mean temperature in the globe, about 4° F., or 20° C. below zero. This was in accordance with their expectations. The tidal observations, only roughly reduced by him at Conger, confirmed the work of 1875-76, but a large number of simultaneous readings at seven special stations in the Polar Sea, Robeson and Kennedy Channels, should enable tidal experts to determine quite accurately the shape and direction of the tidal wave, an important element in the theoretical determination of the configuration of lands and sea-bottom to the north. In Grinnell Land the discovery of coal not only at various points along the sea-coast, but at others in the interior, proved conclusively the changed climatic condition, as did the fossil forest found near Cape Baird in 81° 30′ N. Discoveries of Eskimo remains were of interest as showing the possible extent of this immigration of a new race into the Polar Basin. The Lieutenant next spoke of geographical discoveries. The furthest point seen by Beaumont was Cape Britannia, nearly 50 miles beyond the extreme point actually attained by that heroic officer. From Britannia Island Lieut. Lockwood and Sergeant Brainard pushed on 100 miles further, and passed a day and a half at Lockwood Island, the furthest point by land or sea ever attained by civilised man, in 83° 24′ N., 40° 46′ W. From an elevation of nearly 3000 feet it was evident that no land existed within a radius of sixty miles to the north or north-westward, but to the north-east the Greenland coast yet trended, ending to the eye at Cape Washington in 83° 35′ N. To Greenland was thus added 125 miles of new coast excluding the fiord lines, and from Cape May the mainland was carried a degree of latitude to the northward. In carrying Greenland 10° of longitude further to the eastward, Lieut. Lockwood left but 16° for his successors to fill in. The new land is composed of high precipitous promontories along the coast, and equally broken country inland, in which but three glaciers were seen, none discharging. It was evident that the inland ice-cap of Greenland stopped far to the southward of the 82nd parallel. In short, there existed from Robeson and Kennedy Channels, westward to Greely Fiord and the Polar Sea, a series of fertile valleys clothed with vegetation of luxuriant growth, whereon were large herds of musk oxen. He desired to say a few words as to his discoveries concerning the much-talked-of palæocrystic ice, especially the floebergs from 100 to 1000 feet thick. The opinion advanced by Sir G. Nares that this ice formed over the Arctic Ocean was not borne out by facts, and he could not commit himself to the judgment that this sea was for ever unnavigable, for they knew that a quantity of the ice changed from year to year, and little of it was seen by Lieut. Lockwood to the northward of Cape May. Dr. Moss was certainly correct as to the universality of stratification in this ancient ice, and he concurred in the opinion that its salinity was due to efflorescence and infiltration. There was no doubt in his mind that these floes were simply detachments of slowly-moving glacial ice-caps from an ice-covered land in the neighbourhood of the Pole. Lieut. Lockwood found small floebergs, perhaps 100 to 200 feet thick, detached from the adjacent ice-caps. In Kane Sea he visited a floeberg a third of a mile wide, a quarter of a mile long, and from a fifth to a sixth of a mile thick. The proof as to its terrestrial origin no one would dispute; on its surface were two valleys about 30 feet deep, along which were the medial moraines of the glacier—fully 100 large stones polished and worn smooth in places by the parent ice. He thought it doubtful

whether such an ice-cap increased by more than three or four inches yearly, so that from 3000 to 4000 years might easily have elapsed since the incipient birth of the berg in question. Lieut. Greely advocated future Arctic exploration in the direction of Franz Josef Land.

MR. GAMEL, at whose sole expense the late expedition to the Kara Sea, under Lieut. Hovgaard, was undertaken, intends, provided his enterprise be seconded by the Government, to send his steamer *Dijmphna* next summer on an expedition, under an officer of the Danish Royal Navy, to the east coast of Greenland, to explore and lay down the coast-line between 66°·08, the farthest northward point attained by Capt. Holms's expedition, and 70°.

ACCORDING to the *Gazette Géographique*, M. Moller, who was recently charged with a mission of botanical investigation to the Island of St. Thomas, has returned to Lisbon. He has brought with him a large number of interesting specimens, not only of the botany, but also of the geology, of the island. These have been placed for investigation in the hands of M. Henriques, the Professor of Botany of the Coimbra University. M. Moller has also made some important additions to and corrections in the map of St. Thomas recently published. He has proved that the highest mountain in the island is the Peak of St. Thomas, and that its height is 2142 metres.

AN officer of the French Navy, Commander Réveillère, has succeeded in a daring attempt which he made recently to ascend the rapids of the Meikong, beyond Samboc, in a steamer. Samboc is the chief Cambodian town on the river, and at one time it was thought impossible for a steamer even to reach that point. A short distance above the town commences a series of rapids, which last for about forty miles, and which in parts appear as formidable obstacles to navigation as the cataracts on the Nile. Commander Réveillère, however, succeeded in overcoming them, but only after such exertion and danger as make it clear that in their present state they present an insuperable barrier to navigation for commercial purposes. He proposes a thorough hydrographic study of this section of the river at low water, and he is convinced that the famous barrier will turn out to be merely a mass of trees which has got permanently fixed there and is maintained by annual additions, but which can be removed without difficulty by means of explosives. Beyond the rapids is the town of Stung-Treng, where the greater part of the commerce of the Laos reaches the river, and hence the advantage of a navigable passage. Commander Réveillère concludes his account of his feat by recommending "a serious hydrographic campaign in the rapids of the Meikong, and in the lower Laos." The Meikong is one of the greatest of the great rivers of Asia; it was first thoroughly explored fifteen years ago by a mission under Lagrée and Garnier, which came to the conclusion that this magnificent water-way was useless for trade purposes on account of its rapids.

LIEUT. ALLEN has lately returned to San Francisco from a successful exploration of Alaska, undertaken by direction of the United States Government. He left Sitka in February, going to the mouth of the Copper River, which he ascended as far as the great mountain range of Alaska. He crossed the mountains with snow-shoes, coming to the sources of the Tennah, which river he followed for 800 miles to its junction with the Takon, and he descended this latter river to its mouth, a journey of between 400 and 500 miles. From the mouth of the Takon he went to Fort Michael, on Behring's Straits, whence he came home.

THE proposal that the Netherlands Government should make a grant to the Dutch Geographical Society towards the expenses of the projected scientific expedition for the exploration of the half of New Guinea belonging to Holland has been rejected by the Second Chamber by a large majority, there being forty-nine votes against the motion to twenty-one in favour of it. In the debate most of the speakers expressed their conviction of the desirability of the expedition maintaining the character of a purely private enterprise.

A NEW edition of Dr. Hunter's "Indian Gazetteer of India" in twelve volumes is in the press. Several of the volumes will be published in the course of the next few weeks.

THE November number of the Austrian *Monatsschrift für den Orient* contains a long communication from Dr. Lenz, from Ango-Ango, with reference to his expedition to the Congo. It deals mainly with the superficial aspects of the various settlements on the West Coast of Africa, of the trade there and its future prospects, and especially with the prospects of Austrian trade.

UNDER the title, "La Corée avant les Traités," M. Jametel, a French writer on the Far East, has published, in a *brochure* of about eighty pages, four articles which he contributed to recent numbers of *La Revue de Géographie*. He describes the voyage from Nagasaki to Fusan, a Corean port then only opened to Japanese trade, and gives a sketch of the history of the peninsula from early times; finally he describes the Japanese settlement at Fusan and the neighbouring Corean town of Toraifu, and adds a few words about the Island of Quelpaest. The account is very lively and amusing, but it can hardly be said to add much to our geographical knowledge of Corea, small as that was before the treaties.

## CHLOROPHYLL[1]

ALL who are accustomed to observe vegetation must have been struck with the great variety of shades of green which the foliage of different plants presents. Without pretending to generalise further, it may be stated that, at any rate so far as our common agricultural plants are concerned, they show somewhat characteristic shades of colour, according to the *Natural Order* to which they belong—the Leguminosæ differing from the Gramineæ, the Cruciferæ, the Chenopodiaceæ, and so on. But the same description of plant will exhibit very characteristic differences, not only at different stages of growth, but at the same stage in different conditions of luxuriance, as affected by the external conditions of soil, season, manuring, &c., but especially under the influence of different conditions as to manuring.

The Rothamsted field experiments have afforded ample opportunity for observations of this kind; and it has been quite evident that, in a series of comparable experiments with the same crop, depth of green colour by no means necessarily implied a finally greater amount of carbon assimilation; whilst we have long ago experimentally proved that the deeper colour was associated with relatively high percentage of nitrogen in the dry or solid substance of the herbage; and this obviously means a lower relation of carbon to nitrogen.

Mentioning these facts to Dr. W. J. Russell, who has devoted so much attention to the subject of chlorophyll, he kindly undertook to make comparative determinations of the amounts of chlorophyll in parallel specimens, in which we were to determine the percentages of dry matter and of nitrogen. Accordingly in June, 1882, during the period of active vegation, Dr. Russell spent a day at Rothamsted for the purpose of collecting appropriate samples, which were taken from several differently-manured plots of meadow-grass, wheat, barley, and potatoes, respectively.

The following table gives the results of some of these experiments; namely, the percentages of nitrogen, and the relative amounts of chlorophyll, in the separated gramineous and the separated leguminous plants in the mixed herbage of grass-land; in specimens of wheat grown by a purely nitrogenous manure, and by the same nitrogenous manure with a full mineral manure in addition; and in specimens of barley grown by a purely nitrogenous manure, and by a mixture of the same nitrogenous manure and mineral manure in addition. It is to be borne in mind that the specimens were collected while the plants were still quite green and actively growing. It should be further explained that the amounts of chlorophyll recorded are, as stated in the table, relative and not actual; that is to say, the figures show the relative amounts for the individual members of each pair of experiments, and not the comparative amounts as between one set of experiments and another.

It will be seen in the first place that the separated leguminous herbage of hay contained a much higher percentage of nitrogen in its dry substance than the separated gramineous herbage; and that, with the much higher percentage of nitrogen in the leguminous herbage, there was also a much higher proportion of chlorophyll. Under comparable conditions, however, the Leguminosæ eventually maintain a much higher relation of nitrogen to carbon than the Gramineæ; in other words, in their

[1] "Note on some Conditions of the Development, and of the Activity, of Chlorophyll." By Prof. J. H. Gilbert, LL.D., F.R.S. Read in Section B at the meeting of the British Association at Aberdeen, September, 1885. (Abstract.)

case carbon is not assimilated in so large a proportion to the nitrogen taken up.

Next, it is to be observed that the wheat-plants manured with ammonium-salts alone show a much higher percentage of nitrogen than those manured with the same amount of ammonium-salts but with mineral manure in addition. The high proportion of chlorophyll again goes with the high nitrogen percentage; but the last column of the table shows that, with the ammonium-salts without mineral manure, with the high percentage of nitrogen, and the high proportion of chlorophyll, in the dry substance of the green produce, there is eventually a very much less assimilation of carbon. The result is exactly similar in the case of barley; the plants manured with ammonium-salts alone showing the higher percentage of nitrogen, and the higher proportion of chlorophyll, but eventually a much lower assimilation of carbon.

It is evident that the chlorophyll formation has a close connection with the amount of nitrogen assimilated, but that the carbon assimilation is not in proportion to the chlorophyll formed, if there be a relative deficiency of the necessary mineral constituents available. No doubt there has been as much, or more, of both nitrogen assimilated and chlorophyll formed, over a given area, where the mineral as well as the nitrogenous manure had been applied, the lower proportion of both in the dry matter being due to the greater assimilation of carbon, and consequently greater formation of non-nitrogenous substances.

It is of interest to observe that these results of experiments in the field are perfectly consistent with those obtained by vegetable physiologists in the laboratory; they having found that the presence of certain mineral or ash constituents, and especially that of potassium, is essential for the assimilation of carbon, no starch being formed in the grains of chlorophyll without the aid of that substance. Sachs says:—"Potassium is as essential for the assimilating activity of chlorophyll as iron for its production."

*Relation between Nitrogen Accumulation, Chlorophyll Formation, and Carbon Assimilation.*

The figures in parentheses represent determinations in the not fully dried substance.

| | Nitrogen per cent. in dry substance. | Relative amounts of Chlorophyll. | Carbon assimilated per acre per annum. | |
|---|---|---|---|---|
| | | | Actual. | Difference. |
| HAY— | | | lbs. | lbs. |
| Gramineæ ... ... ... | 1·190 | 0·77 | | |
| Leguminosæ ... ... | 2·478 | 2·40 | | |
| WHEAT— | | | | |
| Ammonium-salts only | (1·227) | 2·00 | 1,398 | – 824 |
| Ammonium-salts and mineral manure ... | (0·566) | 1·00 | 2,222 | |
| BARLEY— | | | | |
| Ammonium-salts only | (1·474) | 3·20 | 1,403 | – 685 |
| Ammonium-salts and mineral manure ... | (0·792) | 1·46 | 2,088 | |

## *CARTOGRAPHICAL WORK IN RUSSIA IN 1884* [1]

THE chief surveys in European Russia are directed towards mapping South Finland, the western frontier on the Duna and Dnieper, and the Government of Taurida. The surveys are made on a scale of 1750 feet to the inch, and the inequalities of soil are represented by horizontal lines received from accurate levellings. Since 1870 about 44,000 square miles have been thus mapped, and, in 1884, 6850 square miles were added to the above, the newly-annexed part of Bessarabia included. The geodetical triangulation for this survey was continued in Poland and Grodno. The work for an orographical map of Russia, which must be based on accurate levellings, has been busily continued since 1881, as also telegraphic determinations of longitudes in Poland.

Instead of the former map of West and Middle Russia, on 150 sheets, on the scale of 3 versts (2 miles) to an inch, the Topographical Department is now preparing a new map on a larger scale (2 versts to an inch), which will be printed on a new method, by helio-engraving, with level-lines in a separate colour. Many preliminary essays having been made, this method has been definitively adopted. The map of Russia (10 versts to an inch) has been completely revised by General Strelbitzky; and the map of the Caucasus, on the same scale, was completed in 1884. The northern and north-eastern sheets of the map of European Russia will be completely revised in accordance with new surveys.

The map of the Asiatic dominions of the Empire, with the neighbouring regions (100 versts to an inch), is completed, and is printed in colours. That of the eastern part of the Balkan peninsula is prepared on two different scales (5 and 3 versts to the inch), and on both maps the inequalities of the soil are represented by horizontal lines. The middle parts, including the Balkan ridge, were ready to print. Helio-engraving had also been resorted to, but it required considerable retouching by the engraver.

Leaving aside the purely military maps of Middle Europe and the statistical maps of the St. Petersburg military district, the following maps, published in 1884, are especially worthy of notice:—The region of the Cossacks of the Ural (10 versts to an inch); the Island of Sakhalin (40 versts); North-Western Mongolia (50 versts), including all the rich materials collected by the expeditions of MM. Potanin, Rafailoff, Orloff, Prjevalsky, Pevtsoff, and several others; Afghanistan (50 versts), according to the surveys and information of M. Lessar; the south-western Turkoman region, by the same (20 versts); the surveys of M. Kosyakoff in Karategin and Darvaz (15 versts); the survey from Staro-Tsurukhaitu to Aigun, on the Amur (25 versts); a map of China proper, by M. Matusovsky (100 versts); the plans of Odessa, Nikolaieff, Ekaterinoslav, Bendery, and Elizabethgrad, as also of Plevna and Lovtcha; the neighbourhoods of Kazan and of Novogeorgievsk, and many others.

On the Caucasus, as soon as the triangulation of the region was terminated some fifteen years since, a series of surveys, on scales of 1400, 1750, and 3500 feet to an inch, were undertaken. Large parts of Transcaucasia were thus mapped. Since 1881 the work has been prosecuted in the central parts of the great Caucasus ridge, in Daghestan, and in the Transcaspian region; about 30,000 square miles were thus surveyed. In 1884 the chief surveys were made in the teritory of Merv, along the Murghab; and on the routes between Kizil-arvat, Petro-alexandrovsk, Khiva, and Merv. The drawing and engraving of the great map of the Caucasus with the neighbouring parts of Persia and Turkey, as also of that of the Transcaspian region, both on a scale of 5 versts to the inch, have been prosecuted.

In Turkestan the chief attention has been directed towards the survey of the former khanate of Kokan, now the province of Ferghana, the work meeting with great difficulties owing to the hilly character of the region and its unhealthy climate. Reconnoitring has been prosecuted in the vassal khanates of Bokhara, west of the Pamir, by a topographer who accompanied Dr. Regel.

The mapping of the town of Tashkend, which covers as much as thirty-five square miles, and where trigonometrical measurements meet with great difficulties on account of refraction and the want of wood for the triangulation-pyramids, a system known under the name of *Polygonale Züge*, and which has been greatly extended of late in Germany, has been resorted to. The horizontal angles were measured by a little universal instrument, and the distances by a ribbon, with the help of the eclimetre. The results obtained were very satisfactory. Several new sheets of the 10 versts map were printed, as also a map of the neighbourhood of Tashkend.

In the Omsk military district, detailed surveys, based on a geodetical net, have been prosecuted since 1870 to the south-west of the Irtish River, between its sources and Pavlodar. In 1883 and 1884 large spaces in the region between Omsk, Pavlodar, Petropaulovsk, and Kokchetav were mapped, and a series of latitudes and longitudes were determined.

In Eastern Siberia the Government of Irkutsk is now surveyed on a scale of one verst to the inch, the trigonometrical net having been completed in 1882. The upper parts of the Vition and Barguzin were reconnoitred, and the trigonometrical net extended in Southern Transbaikalia. On the Pacific coast, the region east of the Suifun River, and on the Chinese frontier, has been surveyed.

[1] *Isvestia* of the Russian Geographical Society, September, 1885.

The following maps, published by the Military Commissariat, deserves also a short notice:—A map of European Russia, showing for each government the surplus, or the want of, rye raised within the government, as also its price, which map leads to very interesting geographical conclusions; a map showing the average crops proportionately to the population; and a map of the sheep-breeding in Russia.

## *UNIVERSITY AND EDUCATIONAL INTELLIGENCE*

CAMBRIDGE.—The first award of the Smith's Prizes under the new regulations has been made. They are now given to the Bachelors of Arts who send in the best essays on any subject in Mathematics or Natural Philosophy before the end of the Lent Term in the second year after each Mathematical Tripos. Thus the competitors this year took their degree in the Mathematical Tripos of 1883–84. The Smith's Prizes this year are awarded to two essays declared equal in merit, viz. that of Mr. H. E. G. Gallop, Fellow of Trinity College, Second Wrangler in 1883, 1st Division in Part III., 1884, subject, "The Distribution of Electricity on the Circular Disk and Spherical Bowl"; and that of Mr. R. Lachlan, Fellow of Trinity College, 3rd Wrangler, 1883, 1st Division in Part III., 1884, subject "Systems of Circles." It is further announced that the essay by Mr. C. Chree, Fellow of King's College, on "Elastic Solids," and that of Mr. A. N. Whitehead, Fellow of Trinity College, on the "General Equations of Hydrodynamics," deserved honourable mention.

The Special Board for Medicine have reported in favour of the immediate appointment of a Demonstrator of Pathology, with a stipend of 100*l.* a year, to assist Prof. Roy, who now gives systematic lectures three times a week, conducts a practical course for two hours twice a week, and undertakes the autopsies at Addenbrooke's Hospital.

The Chemical Laboratory Syndicate have recommended the acceptance of Messrs. Bull, Sons, and Co.'s tender (Southampton) for 19,300*l.*

The following appointments to Syndicates and Boards have been made:—

Botanic Garden: Messrs. A. H. Cooke and W. Gardiner.
University Library: Prof. A. Macalister.
Museums and Lecture Rooms: Messrs. E. H. Morgan and R. T. Caldwell.
Local Examinations: Mr. J. W. Hicks.
Observatory: Dr. Routh and Mr. J. Larmor.
University Press: Prof. A. Macalister.
State Medicine: Prof. Latham and Dr. D. McAlister.
Mathematics: Dr. Routh.
Physics and Chemistry: Mr. C. Trotter.
Biology and Geology: Mr. W. Gardiner.

Great opposition has been given to the new proposals as to the additional subjects of the Previous Examination required of candidates for honours. As Mr. Oscar Browning said, "dealing with this subject seemed to cast an evil influence over every one who takes it in hand." The fact is the University, containing strong elements attached to and connected with the Public School system, refuses to boldly grasp the nettle and introduce English, Modern Languages, or Physical Science into its schemes for the Ordinary Preliminary Examination, and finds itself consequently in endless difficulties whenever it touches the question.

IN addition to the practical instruction in Biology (Zoology and Botany), in preparation for the Preliminary Scientific and B.Sc. Examinations at the University of London, which we have already announced as being given at Bedford (Ladies') College, York Place, Baker Street, we are informed that a class in Geology and Physical Geography has now been formed, in accordance with the requirements of the University, and that it will be conducted by Miss Mary Forster.

## *SOCIETIES AND ACADEMIES*

### LONDON

**Chemical Society,** November 5.—Dr. Hugo Müller, F.R.S., President, in the chair.—Mr. Leonard de Koningh was admitted a Fellow of the Society.—The following papers were read:—The influence of silicon on the properties of cast iron, part 2, by Thomas Turner, Assoc. R.S.M.—Modifications of double sulphates, by Spencer Umfreville Pickering, M.A.—The relation of diazobenzene-anilide to amidoazobenzene, by R. J. Friswell and A. Green.—An examination of the phenol constituents of blast-furnace tar obtained by the Alexander and McCosh process at the Gartsherrie Iron Works, part 1, by Watson Smith, J. F. H. Coutts, and H. E. Brothers.—The decomposition of potassium chlorate by heat, by Frank L. Teed, F.C.S. Note on the refractive power of metacinname (metastyrole), by H. G. Madan, M.A., F.C.S.

**Zoological Society,** November 17.—Prof. W. H. Flower, F.R.S., President, in the chair.—The Secretary exhibited to the meeting two curious Millipedes, believed to be *Spirostreptus annulipes*, which had been sent home from the Cape by Mr. Fisk for the Insect House.—An extract was read from a letter addressed to the Secretary by Major S. W. Yerbury, respecting the exact locality of a Chameleon (*Chamæleon calcarifer*) presented to the Society by that gentleman in June, 1885. Major Yerbury had obtained this specimen near Aden.—Mr. Sclater exhibited and made remarks upon two Newts (*Molge vittata*) transmitted to the Society by Dr. E. B. Dickson, of Constantinople, C.M.Z.S., by whom they had been obtained from Brussa, Asia Minor.—Mr. H. E. Dresser exhibited and made remarks on a female specimen of the Kildeer Plover (*Ægialitis vocifera*), killed, in January, 1885, by Mr. Jenkinson on the Scilly Isles; and a young female Desert-Chat (*Saxicola deserti*) obtained near Spurn Head, Lincolnshire, in October, 1885.—Prof. F. Jeffrey Bell exhibited and gave an account of a specimen of a species of *Balanoglossus* obtained by Mr. Spencer at Herm, Channel Islands, being the first recorded instance of the occurrence of this Hemichordate in any part of the British seas.—Mr. F. E. Beddard read the first of a proposed series of notes on the visceral anatomy of birds. The present paper treated of the so-called omentum of birds and its homologies. It was pointed out that this structure, present in many birds, but apparently absent, or only present in rudiment, in a few others, was represented by a structure having similar relations in the Crocodile, but in no other reptile.—Mr. Oldfield Thomas read a description of *Heterocephalus phillipsi*, an extremely remarkable burrowing Rodent from Somali-land, belonging to a genus of which the only other known species was based upon a single specimen obtained by Rüppell's collector in Schoa. Mr. Thomas considered the affinities of this Rodent to be with *Georychus* and *Bathyergus*.—Mr. Sclater read a paper containing a description of an apparently new species of Tanager of the genus *Calliste*, based on a specimen formerly in the Gould Collection, now in the British Museum. Mr. Sclater proposed to dedicate this bird to its former owner as *Calliste gouldi*.—Mr. Boulenger gave the description of a new frog from Perak, Malacca, which he proposed to name *Megalophrys longipes*.

**Physical Society,** November 14.—Prof. Guthrie, President, in the chair.—Mr. G. M. Whipple described and demonstrated experimentally the process of testing thermometers at and near the melting-point of mercury, as carried on at Kew. About 20 lbs. of mercury are poured into a wooden bowl and frozen by carbonic-acid-snow and ether; the mercury is stirred with a wooden stirrer, and the snow is added till the experimenter feels, by the resistance to stirring, that the mercury is freezing. The stirring is continued for some time, which causes the mercury to become granular instead of a solid mass. The thermometers are then inserted, together with a standard, and compared. About 100 mercury or 40 spirit thermometers can be thus examined in half an hour, using about 200 gallons of carbonic acid gas compressed sufficiently to form the snow. The bowl, ether, and mercury are cooled first to $-10°$ C. by an ordinary freezing-mixture. The average correction at the melting-point of mercury is now less than $1°$ F.; when the process was introduced in 1872 it amounted to $5°$, but has steadily decreased.—On the electromotive force of certain tin cells, by Mr. E. J. Herroun. Mr. Herroun has examined the electromotive forces of cells in which tin in a solution of its salts was opposed to copper, cadmium, and zinc in solutions of their corresponding salts, the solutions being of equal molecular strengths. The salts used were sulphates, chlorides, and iodides, and the cells were of the ordinary "Daniel" form, with a porous vessel. To prevent the formation of basic salts it was necessary to add a little free acid to the solution of the tin salt, and, to counterbalance the influence of this acid upon the E.M.F. as far as possible, an equal proportion of free acid was added to the othe

solution. Prof. G. Minchin pointed out the importance of performing these and similar experiments upon tin in the dark, as, by allowing light to fall upon the tin plate, a considerable photo-electric effect would be obtained. Prof. Fleming insisted upon the great importance of temperature corrections in all experiments upon two-fluid cells.—On the law of the electro-magnet and the law of the dynamo, by Prof. S. P. Thompson. It cannot be said up to now that any particular law has been generally accepted, giving the relation between the current in the coils of an electro-magnet and the magnetism induced by it in the core. Many empirical formulæ have been given, most of which are entirely wrong. One, however, recently enunciated by Fröhlich, gives a relation which agrees very closely with observed values. This formula is—

$$m = \frac{i}{a + bi},$$

where $m$ is the magnetic moment of the core, $i$ the current, and $a$ and $b$ constants depending upon the geometrical form of the magnet, and the nature and previous history of the iron core. Fröhlich obtained this relation by experimenting with a series-dynamo. It is purely empirical, but since it agrees so well with the facts as to give values for the magnetism of the core agreeing almost within experimental error with those observed, there is great probability of some law being at its base. And this law Prof. Thompson believes to be one that was stated years ago by Lamont:—"The magnetic permeability varies with the quantity of magnetism the iron is capable of taking up." This may be expressed by the formula—

$$\frac{dm}{di} = k(M - m.)$$

Integrating which and expanding $e^{-ki}$ in powers of $i$—

$$m = Mki\left\{1 - \frac{ki}{2} + \frac{k^2 i^2}{6} \ldots\right\}.$$

Expanding Fröhlich's equation, in powers of $i$, we get—

$$m = \frac{i}{a}\left\{1 - \frac{bi}{a} + \frac{b^2 i^2}{a^2} - \ldots\right\}.$$

If $ki$ is not great these expressions will coincide in form very closely, and the results lead Prof. Thompson to accept Lamont's expression as being that of a real physical law. Prof. Perry suggested that Lamont's law gave good results from its being an approximation to Weber's theory of induced magnetism, but Prof. Thompson maintained that it represented observed facts better than that theory, which, as developed by Maxwell, shows a decided discontinuity in the process of magnetisation not actually observed. Prof. Fleming remarked upon the similarity of Fröhlich's expression to that for the current through a voltameter; the part $a + bi$ corresponding to the apparent resistance, which may be considered in this case as the resistance to magnetisation of the core-air circuit, and which, like that of the voltameter, varies with the current.

**Geological Society**, November 4.—Prof. T. G. Bonney, F.R.S., President, in the chair.—Dr. A. G. Nathorst, of Stockholm, was elected a Foreign Correspondent of the Society.—The following communications were read:—On the premaxillaries and scalpriform teeth of a large extinct wombat (*Phascolomys curvirostris*, Ow.), by Sir Richard Owen, K.C.B., F.R.S. The specimen described in this paper is a cast from a fossil discovered in a late exploration of the Wellington bone-caves, and sent to the author with some other casts from the same collection by the authorities of the Australian Museum, Sydney, New South Wales. The fragments in question consist of the premaxillary bones, containing a pair of scalpriform incisors, 160 mm. (6½ inches) long, measured along the outer curve. The teeth and the fragments of bone in which they are implanted were described in detail, and referred to the wombat family. The animal to which they belonged must have been somewhat larger than *Phascolomys medius*, Owen, but less than the type of the sub-genus *Phascolomys*. The specific name is suggested by the chief characters that distinguish the present form from any hitherto known, recent or extinct.—On the structure and classificatory position of some Madreporaria from the secondary strata of England and South Wales, by Prof. P. Martin Duncan, F.R.S. This paper consisted chiefly of a criticism of the conclusions arrived at by Mr. R. F. Tomes in various papers communicated to the Society.—On the *Astrocœniæ* of the Sutton Stone of the Infra-Lias of South Wales, by Prof. P. Martin Duncan, F.R.S.

**Anthropological Institute**, November 10.—Mr. F. Galton, F.R.S., President, in the chair.—The following elections were announced:—Prince Roland Bonaparte, Hon. Member; Dr. A. Asher, Dr. Alexander Bain, and Messrs. C. F. Clarke, J. W. Crombie, T. H. Edwards, P. Norman, and E. Tregear, as Ordinary Members.—This being the first meeting of the Session, the President made some opening remarks, in the course of which he congratulated the Institute upon the obvious increase of public interest in the science of man. Besides the gratifying facts that more new members are joining the Institute and that the corresponding Section of the British Association was popular, there are such evidences as that the authorities of Trinity College, Cambridge, have extended the tenure of one of their Fellowships to enable its holder to pursue his anthropological studies, and that at the meeting of the British Association at Aberdeen it was the Rector of the University, Dr. Bain, who contributed one of the most thoughtful of the anthropological memoirs. Mr. Galton proceeded to insist upon the political value of anthropology as the science that best qualifies us to sympathise with other races and to regard them as kinsmen rather than as aliens.—A paper containing a short account of some experiments in testing the character of school children as observers, was read by Mrs. Bryant. In these experiments an attempt was made to read signs of character in an observer from the manner in which he makes an observation and describes it as made. From the written description of (1) a room, (2) a picture, which the children experimented upon were first shown and then required to describe, a rough diagnosis of their character as observers can be made, and hence some idea of their character generally is obtained, which, though very deficient in precision and still more deficient in certainty, may have, nevertheless, a real practical value for educational and other purposes. In the experiments made the most interesting points noticed were:—(1) great variety in the proportions existing between the sensational and intellectual factors of perception; (2) the occasional prevalence of the tendency to substitute feeling for thinking, which is a very characteristic feature of general character where it exists; (3) varieties in degree and kind of orderliness; (4) differences in the degree of colour-interest, as also of interest in form and number; (5) great variety in degree and kind of imaginative play, as shown in the efforts of constructive explanation required to describe a picture.—Mr. Joseph Jacobs then read a paper entitled "A Comparative Estimate of Jewish Ability." In it he applied the same method to Jews and Scotchmen as Mr. Galton had applied to Englishmen in his "Hereditary Genius," with results favourable to the two former races in the order mentioned. The subjects in which Jews seemed to show superior ability were philology, music, metaphysics, and finance.

**Royal Meteorological Society**, November 18.—Mr. R. H. Scott, F.R.S., President, in the chair.—Messrs. T. R. H. Clunn, R. S. Davies, B.A., H. C. Fox, M.R.C.S., W. E. Jackson, J. Richardson, M.Inst.C.E., F.G.S., A. L. Rotch, and C. Todd, C.M.G., were elected Fellows of the Society.—The following papers were read:—The Helm wind of August 19, 1885, by William Marriott, F.R.Met.Soc. This wind is peculiar to the Cross Fell range, Cumberland, and is quite local, but very destructive. The chief features of the phenomenon are the following:—On certain occasions when the wind is from some easterly point, the helm suddenly forms. At first a heavy bank of cloud rests along the Cross Fell range, at times reaching some distance down the western slopes, and at others hovering above the summit; then at a distance of one or two miles from the foot of the Fell there appears a roll of cloud suspended in mid-air and parallel with the helm cloud: this is the helm bar. A cold wind rushes down the sides of the Fell and blows violently till it reaches a spot nearly underneath the helm bar, where it suddenly ceases. The space between the helm cloud and the bar is usually quite clear, blue sky being visible. At times, however, small portions of thin vaporous clouds are seen travelling from the helm cloud to the bar. The bar does not appear to extend further west than the River Eden. The author visited the district in August last, and was fortunate enough to witness a slight helm. He gives a detailed account of what he experienced, and also his observations on the temperature of the air at the summit and base of Cross Fell, the direction and force of the wind, the movement of the clouds, &c.—The typhoon origin of the weather over the British Isles during

the second half of October, 1882, by Henry Harries. The author shows, by means of daily charts, that a typhoon which originated near the Philippine Islands on September 27 passed over Japan and the Aleutian Archipelago, entering the United States on October 10. Crossing the Rocky Mountain range, it proceeded through the Northern States and Canada to Labrador and Davis Strait. In the Atlantic it was joined on the 18th by another disturbance which had come up from the Atlantic tropics, the junction of the two being followed by a cessation of progressive movement from the 19th to the 25th. During this period the severe gale which passed along our southern counties on the morning of the 24th was formed, its sudden arrival upsetting the Meteorological Office forecasts of the previous night. Observations are quoted showing that it would have been impossible for the Department to have been aware of its existence before about 3 a.m. of the 24th. Following in the wake of this storm the parent cyclone reached the French coast on the 27th, its advent being marked, as in Japan and America, by violent gales and extensive floods over the whole of Western and Central Europe and Algeria. The village of Grindelwald was destroyed, and in the Austrian Tyrol the damage caused by floods reached at least two millions sterling. Passing through France and the Netherlands the disturbance showed signs of exhaustion, and on November 1, in the Baltic, it quietly dispersed, after accomplishing a journey of over 16,000 miles in thirty-six days. This is the first storm which has been followed day by day from the Pacific to Europe.—Notes as to the principle and working of Jordan's photographic sunshine-recorder, by J. B. Jordan and F. Gaster, F.R.Met.Soc. This instrument consists of a cylindrical dark chamber, on the inside of which is placed a prepared slip of photographic paper. The direct ray of sunlight being admitted into this chamber by small apertures in the side, is received on the sensitised paper, and, travelling over it by reason of the earth's rotation, leaves a distinct trace of chemical action whenever the light is of sufficient intensity to show a definite shadow on a sun-dial. The cylinder is mounted on a stand with adjustments for latitude, &c. The record is fixed by simply immersing it in water for a few minutes. As this instrument records the actinic or chemical rays, it usually shows more sunshine than is obtained by the ordinary "burning" sunshine-recorder.

### Edinburgh

**Mathematical Society**, November 13.—Mr. George Thom, Vice-President, in the chair.—Sir William Thomson communicated a theorem in determinants, which was read by Dr. Muir. Mr. J. S. Mackay gave an account of the ancient methods for the duplication of the cube.—Mr. William Harvey contributed some geometrical notes.—Mr. A. J. G. Barclay read a paper on physical science in schools.—The following office-bearers were elected:—President: Dr. R. M. Ferguson; Vice-President: Mr. George Thom; Secretary: Mr. A. Y. Fraser; Treasurer: Mr. John Alison; Committee: Messrs. R. E. Allardice, A. J. G. Barclay, W. T. Macdonald, J. S. Mackay, Dr. Thomas Muir, Mr. William Peddie.

### Paris

**Academy of Sciences**, November 16.—M. Jurien de la Gravière in the chair.—Researches tending to show that the trigemini nerves contain, from the first, vaso-dilatator fibres, by M. Vulpian.—Obituary notice of the late W. B. Carpenter, Corresponding Member for the Section of Zoology, by M. A. Milne-Edwards.—Treatment of the vine by a mixture of lime and sulphate of copper: determination of the distribution of the copper on the plant, and its persistence in the fruit and must, by MM. Millardet and Gayon. From these researches it appears that most of the copper remains deposited on the leaves, the must containing extremely small quantities, and the wine only doubtful traces, or at most 0·1 gramme in 1000 litres.—Letter accompanying the presentation of a new edition of Ptolemy's "Optics," by M. Gilbert Govi.—On the irregular integrals of linear equations, by M. H. Poincaré.—Dynamic effects produced by the passage of locomotive and carriage wheels at the junction of the rails, by M. A. Considère. It is shown that these effects constitute a new and important element in estimating the wear and tear of traffic on the metals of railways. Several experiments show that they are much more serious at the points of contact of the rails than had hitherto been supposed.—On the tension of saturated vapours, by M. E. Sarrau.—Theory of refrigerating mixtures, by M. A. Potier.—Theory of the flow of gases: adiabatic lines, by M. Marcellin Langlois.—On the theory of the receptor electro-magnetic telephone, by M. E. Mercadier.—Description of a new spectroscopic optometer, by M. Ch. V. Zenger. Besides its use in spectroscopic studies, this ingenious little instrument is expected to render great services to physiologists in determining the defective achromatism of the human eye and its variations with age.—Spectroscopic study of the flames of blast furnaces and of the Bessemer process, by M. Ch. V. Zenger.—On the numerical laws of the chemical equilibria, by M. H. Le Chatelier.—Fixation of free atmospheric nitrogen in cultivated ground, by M. H. Joulie.—Note on the physiological action of safranine, and of the crystallised sulfo de fuchsine used in colouring wines, by MM. P. Cazeneuve and R. Lépine. From various experiments made on dogs, pigs, and human subjects, the authors conclude that the fuchsine is a perfectly harmless substance without physiological or therapeutic interest, whereas safranine gives rises to serious toxic phenomena when injected into the veins in a solution of salt water containing 7 per cent. of this substance.—Note on the zymotic properties of charbon and some other kinds of virus, by M. S. Arloing.—Researches on the comparative anatomy of the chord of the tympanum in birds, by M. L. Magnien.—Note on the nerve centres of the cephalopods, by M. Vialleton.—Influence of the number of individuals in the same vessel, and of the form of the vessel on the development of the larvæ of the frog (*Rana esculenta*), by M. E. Yung. The author finds that the rapidity of development is in inverse ratio to the number of tadpoles in the vase, although the supply of food may be superabundant; also that the development is the more rapid the larger the diameter (and consequently of the surface exposed to the air) of the vessels.—Note on the respiration of leaves in the dark, by MM. Dehérain and Maquenne.—On the variations presented by the composition of the gases in the foliage of plants growing in the air, by M. J. Peyron.—Note on the floral polymorphism of aquatic ranunculi, by M. Louis Crié.—A study of the Quaternary deposits in the district of Perreux, east of Paris, by M. Emile Rivière.—Note on an experiment undertaken to determine the direction of the Atlantic currents, by the Prince of Monaco.—Observation of the crepuscular lights on November 2 and 16, in Paris, by M. A. Boillot.

### Berlin

**Physical Society**, October 23.—Prof. Neesen reported on the experiments he had made on sounding air columns, with the object of determining the relation of Kundt's dust-figures to the tone-pitch. By means of an electric tuning-fork, whose tone-pitch, through the imposition of weights, might be variously modified, the air was maintained in permanent vibration in a glass tube closed at the bottom by a membrane, and the intervals of the sand-ribs from each other measured. To further extend the scale of tone-pitches, rubbed pieces of wood were utilised as sources of sound. The very numerous measurements taken led to a negative result, no relation of the intervals of the ribs from each other to the tone-pitch could be established. On the other hand, however, the speaker succeeded in making some interesting observations of a different kind and prosecuting them to an important stage. He first established that the long-known wandering of the ribs in a permanently sounding tube stood in no demonstrable relation to the vibrations of the air, and in one and the same tube was found at one place directed one way, and at another place another way. Herr Dworzak's presentation of the matter, that this wandering of the ribs was induced by air-currents setting in at the wall of the tube in one direction, and at the middle in another, the speaker was unable to confirm. The cause of the wandering of the ribs could not be ascertained. On the subject of the origin of the ribs several observations had been made, at spots in the tube, namely, where the wanderings of the ribs issued in contrary directions, and where, accordingly, comparative rest obtained. Here, first, a cork sand granule was seen executing movements hither and thither, in which, shortly, ever more and more granules, and at last a whole series, took part. This layer of granules next began to roll up towards the sides, growing ever thicker in the process, and ending in the formation of a rib. The ribs further showed elevations of a character like to that of waterspouts, the branches of which, falling downwards, assumed the shape of whirls, and returned to the rib. On viewing them with intermittent light, these formations appeared at rest, when the number of light intermissions corresponded with the number of vibrations of the exciting sound. A

very interesting phenomenon was observed on taking the measurements of pressure in the sounding-tube. A narrow glass tube, open on both sides, with an oil index, the movements of which were observed, served as manometer. No displacement of the index was ever noticed, but out of the interior end of the manometrical tube there appeared to issue a current of air impelling the cork sand a long way. This current of air was stronger when the mouth of the narrow tube was conical than when it was cylindrical. The current of air was present both when the upper end of the tube was open and when it was closed, as also when the lower end turned towards the source of sound was diverted from it, in consequence of an incurvation. The current of air was finally identified at all points of the sounding-air column, but the intensity of the apparent air-current varied according as the lower end was in the belly or in the node of the tube, and according to its length. The maxima of the current were more pronounced than the minima. If the upper end were likewise in the sounding-tube, then was there a current from the manometrical tube forthcoming. The index in the manometer, however, remained persistently unmoved, a demonstration that in point of fact there was no actual current in the narrow tube. The strength of the apparent air-current might be measured by little mills, and when small radiometers with paper wings were introduced into the sounding-tube, they fell into very lively rotation. If instead of full paper wings the radiometers had small conical paper tubes, directed all alike, they rotated just as fast, and in just the same manner as did the other radiometers. When, however, one approached the node of the sounding-tube, the rotation became slower, ceased, assumed the contrary direction, in order, after further progress, to pause again, and next pass into the former lively rotation. The fast rotation of the sound radiometers Prof. Neesen explained as anemometrical movements which, as was known, were independent of the direction of the wind. The contrary movement of the tube radiometers in the node were explained as determined by the currents of air in the little tubes which had been observed in the manometers as stated above; they entered into the phenomena in which the vibratory movements were less. The attractions and repulsions produced by the sound appear to be based on similar processes.

**Meteorological Society**, November 3.—With reference to a recent publication of Dr. Lender, Prof. Spörer made some observations regarding the line of demarcation which must be drawn between meteorology and hygiene, and by way of illustration related a number of personal experiences gathered in the course of his stay in the tropics, pointing out how the explanation of them did not properly belong to the office of meteorology.—A paper on the brown ring and the solar eclipses, by Dr. Zenker, who was unable to be present, was read. The abnormal sunset glows which had appeared in the skies since the autumn of 1883 and the brown-red ring round the sun were still visible, though n reduced intensity. The fact that these phenomena were not earlier observed showed that they owed their existence to something novel which had been introduced into the atmosphere, and were not at all due to the presence of ice-crystals or globules of fog in the higher strata of the air. The fine particles giving rise to the reflex-phenomena in question might be of terrestrial or of cosmic origin. The first of these two assumptions had to contend with the facts that the dust concerned with the phenomena kept so long afloat that the constituent dust-particles were of a very different character from that of the Krakatão ashes, and that it was at very great altitudes that they appeared to be suspended. Against the second of these assumptions—that, namely, of their cosmic origin—there was the fact of the absence of metallic particles from the dust and also the fact that the dust was found occurring likewise in lower strata. No decision had yet been arrived at in the matter, and it was therefore of great importance to determine precisely the altitude of the dust-cloud floating above the earth. The measurements hitherto taken had yielded very different results. In this respect it was a most striking fact that on one and the same day in Steglitz, near Berlin, the height of the reflecting dust was calculated from the glowing phenomena at from 2 to 17 kilometres, while in Dresden the glow was observed the whole night; and that for the end of the astronomical twilight about midnight, on taking a single reflection, the height of the reflecting surface gave itself as equal to 900 kilometres, and, on taking a double reflection, showed a height of from 200 to 300 kilometres. Dr. Zenker suggested that on the occurrence of the next solar eclipses observations of the brown ring be made. For the zone of totality he calculated the formulæ for the exact determination of the height of the dust-cloud. These formulæ were not communicated, because the paper itself would shortly appear in the *Meteorologische Zeitschrift*. It was only briefly mentioned that if during the totality the whole of the brown-red ring were seen, a height of $6r$ would be the result, $r$ being the diameter of the cone of shadow. An exact representation of the total solar eclipse in the year 1886, visible in America, and that of 1887, visible in Europe and Asia, was appended to the paper.—In the discussion which followed the reading of this paper Prof. von Bezold referred to the fact that the brown ring was very difficult of perception in the plain, being not at all visible in Berlin, for example; while even at a slight elevation it could be very beautifully observed. He further advised caution against the assumption that the brilliant sunset phenomena were something entirely new. He himself occasionally observed such phenomena as far back as 1863, though it was formerly not possible to awaken general interest in the spectacle as can now be done. Regarding the brown ring, too, he conjectured that it had been formerly seen, though attention had not been paid to it.

VIENNA

**Imperial Academy of Sciences**, July 9.—On some experiments made on total reflection and abnormal dispersion, by E. Mach and T. Arbes.—Experiments on electrical double-refraction of liquids, by G. Taumann.—On phenomena of absorption in crystals of zircon, by E. Linschmann.—On a mite (*Tarsonemus intectus*, n.sp.) living on man and corn, by L. Karpelles.—On the epithelium of the mouth of *Salamandra maculata*, by M. Holl.—On the determination of solubility of some salts in water at different temperatures, by G. A. Raupenstrauch.—On the botanical results of Dr. Polak's expedition to Persia in the year 1882, by O. Stapf.—On the development of chlorophyll-corpuscles, by K. Mikosch.—Determination of the orbit of the Kriemhild (242) planet, by N. Herz.—On rotation and precession of a liquid spheroid, by S. Oppenheim.

## CONTENTS